

**US Army Corps  
of Engineers**  
Louisville District

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# **Solicitation for**

## **Ammunition Supply Point Fort Dix, New Jersey**

**9 August 1999**

SFB DACA27-99-B-0025

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<b>SOLICITATION, OFFER, AND AWARD</b> <i>(Construction, Alteration, or Repair)</i>	1. SOLICITATION NO. DACA27-99-B-0025	2. TYPE OF SOLICITATION <input checked="" type="checkbox"/> SEALED BID (SFB) <input type="checkbox"/> NEGOTIATED	3. DATE ISSUED 9 Aug. 1999	PAGE OF PAGES 1 of 5
	<b>IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.</b>			

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.
7. ISSUED BY  U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place Louisville, Kentucky 40202-2230	CODE	8. ADDRESS OFFER TO  U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place, Room 821 Louisville, Kentucky 40202-2230
9. FOR INFORMATION CALL:	A. NAME See Instructions	B. TELEPHONE NO. (Include area code) <b>(NO COLLECT CALLS)</b> See Instruction

**SOLICITATION**

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder."

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying no., date):

**AMMUNITION SUPPLY POINT, FORT DIX, NEW JERSEY**

This project consist of a 2,000 sf operations building, a 5,000 sf inspection building, an 8,600 sf residue turn-in building, eight (8) 2,000 sf ammunition igloos, connecting roadways, fencing, water supply well, overhead and underground telephone and other supporting utilities.

The estimated cost range of this project is from \$5,000,000.00 to \$10,000,000.00

**BID MODIFICATIONS RECEIVED BY FACSIMILE OR TELETYPE WILL NOT BE CONSIDERED.**

AWARD IS BEING MADE PURSUANT TO THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM.

DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) FAR 52.211-14: This is a rated order certified for national defense use and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR

11. The Contractor shall begin performance within 10 calendar days and complete it within \*\* calendar days after receiving  award,  notice to proceed. This performance period is  mandatory,  negotiable. (See **\*\*Section 00800, Para 1.**)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	12B. CALENDAR DAYS  10
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13. ADDITIONAL SOLICITATION REQUIREMENTS:

- A. Sealed offers in original and 2 copies to perform the work required are due at the place specified in Item 8 by 2:00 p.m. local time 8 September 1999. If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.
- B. An offer guarantee  is,  is not required.
- C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.
- D. Offers providing less than 120 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

14. NAME AND ADDRESS OF OFFEROR <i>(Include ZIP Code)</i>  DUNS #  CODE                      FACILITY CODE	15. TELEPHONE NO. <i>(Include area code)</i>  16. REMITTANCE ADDRESS <i>(Include only if different than Item 14)</i>  TIN #
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17. The offeror agrees to perform the work at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government within   120   calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)*

AMOUNTS                      Bidders shall show his prices on the Bid Schedule of this section.

18. The offeror agrees to furnish any required performance and payment bonds.

**19. ACKNOWLEDGMENT OF AMENDMENTS**

*The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each*

AMENDMENT NO.									
DATE									

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER <i>(Type or print)</i>	20B. SIGNATURE	20C. OFFER DATE
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**AWARD (To be completed by Government)**

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA
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24. SUBMIT INVOICES TO ADDRESS SHOWN IN <i>(4 copies unless otherwise specified) Will be identified in Delegation letters.</i>	ITEM: Sec 105 Para. 30	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO <input type="checkbox"/> 10 U.S.C. 2304(c)( ) <input type="checkbox"/> 41 U.S.C. 253(c)( )
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26. ADMINISTERED BY                      CODE U.S. Army Engineer District, Louisville Corps of Engineers, P.O. Box 59 Louisville, KY 40201-0059	27. PAYMENT WILL BE MADE BY USACE Finance Ctr. (UFC) 5720 Integrity Drive                      EFT:T Millington, TN 38054-5005
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**CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE**

<input type="checkbox"/> 28. NEGOTIATED AGREEMENT <i>(Contractor is required to sign this document and return ___ copies to issuing office.)</i> Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration slated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.	<input type="checkbox"/> 29. AWARD <i>(Contractor is not required to sign this document)</i> Your offer on this solicitation is hereby accepted as to the item listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.
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30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN <i>(Type or print)</i>	31A. NAME OF CONTRACTING OFFICER <i>(Type or print)</i>
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30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA  BY	31C. AWARD DATE
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ALL BIDDERS READ THE FOLLOWING INSTRUCTIONS

1. Each bidder shall, upon request of the Contracting Officer, furnish a list of the plant available to the bidder and proposed for use of the work.
2. Bidders are cautioned that drawings may not be reproduced to exact scale. All drawings, whether full size or reduced, should be checked for potential discrepancies, dimensions and scales should be verified and all drawings compared.
3. Bidders are required to acknowledge receipt of all amendments to this solicitation on Standard Form 1442 in the space provided, by completing Blocks 8 and 15 of the Amendment Form (SF 30), by separate letter, or by telegram prior to opening of bids. Failure to acknowledge all amendments may cause rejection of the bid/proposal.
4. Telegraph modifications may be received at the bidding office by telephone from the receiving telegraph company. The telegraph company shall call (502) 582-5591 to deliver the message. The telegraph company shall confirm the message by sending a copy of the written telegram to the bidding office within 7 calendar days of delivery of the telephone message.

# **CAUTION TO BIDDERS**

**BEFORE SIGNING AND MAILING THIS BID, PLEASE TAKE NOTE OF THE FOLLOWING, AS FAILURE TO PERFORM ANY ONE OF THESE ACTIONS MAY CAUSE YOUR BID TO BE REJECTED.**

1. **AMENDMENTS**. Have you acknowledge receipt of ALL amendments? If in doubt as to the number of amendments issued, please contact our office.
2. **AMENDED BID PAGES**. If any of the amendments furnished amended bid pages, the amended bid pages must be used for preparation of your bid.
3. **LATE BIDS**. Please refer to the Instructions section contained in this package.
4. **BID GUARANTEE**. If bid guarantee is required for this project, sufficient bid guarantee in proper form must be furnished with your bid for construction projects exceeding \$100,000.
5. **MISTAKE IN BID**. Have you reviewed your bid prices for possible errors in calculations or work left out?
6. **FAX MODIFICATIONS OF BIDS**. We do not permit modifications of bids by fax.

**BID SCHEDULE****CONTINUATION SHEET**

REFERENCE NO. DOCUMENT BEING CONTUNUED

PAGE 5 of 5

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NAME OF OFFEROR OR CONTRACTOR

ITEM NO.	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
	Fort Dix, New Jersey Ammunition Supply Point				
1	Inspection Building to the five (5) foot line.	1	JOB		\$ _____
2	Residue Turn-In Building to the five (5) foot line.	1	JOB		\$ _____
3	Operations Building to the five (5) foot line.	1	JOB		\$ _____
4	Pump House Building to the five (5) foot line.	1	JOB		\$ _____
5	Eight (8) Storage Magazines to the five (5) foot line.	1	JOB		\$ _____
6	Site Work	1	JOB		\$ _____
	<b>TOTAL BASE</b>				\$ _____
1	<b>BID OPTIONS</b>				
	Two (2) Ammunition Storage Magazine, including site work	1	JOB		\$ _____
	<b>Total Base Bid and Option</b>				\$ _____
	Prices for the options shall be good for <u>90</u> days after award of the contract. The project duration shown in Section 00800, para. 1 will not be affected by the exercising of the options.				
	<u>Special Bid Conditions.</u> If a modification to a bid based on unit prices is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.				

16 February 1999

## SECTION 00100

## INSTRUCTIONS FOR SEALED BID CONTRACTS

2 Jan 96

## 1. SOLICITATION DEFINITIONS - SEALED BIDDING - (July 1987) FAR 52.214-1.

"Government" means United States Government. "Offer" means "bid" in sealed bidding. "Solicitation" means an invitation for bids in sealed bidding.

## 2. AMENDMENTS TO INVITATIONS FOR BIDS (DEC 1989) FAR 52.214-3.

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, 3) by letter or telegram, or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids.

## 3. FALSE STATEMENTS IN BIDS (APR 1984) FAR 52.214-4.

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

20 March 1997

## 4. SUBMISSION OF BIDS (MAR 1997) FAR 52.214-5 (Para. a-e only).

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages, (unless submitted by electronic means).

- (1) Addressed to: U.S. Army Engineer District, Louisville  
600 Dr. Martin Luther King, Jr. Place  
Room 821  
Louisville, Kentucky 40202-2230

(2) Showing the time specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a)(1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice.

(d) Facsimile bids, modifications, or withdrawals will not be considered unless authorized by the solicitation.

(e) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.

(f) Hand-carried bids shall be deposited in the depository located in Room 821, Federal Building, 600 Dr. Martin Luther King, Jr. Place, Louisville, Kentucky.

(g) Express mail bids shall be addressed as shown in Paragraph (a) (1) above, ATTN: CEORLCT/Hitner.

5. EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984) FAR 52.214-6.

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

20 March 1997

6. LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (MAY 1997)  
FAR 52.214-7.

(a) Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it--

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for the receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th); or

(2) Was sent by mail (or telegram or facsimile, if authorized) or hand-carried (including delivery by a commercial carrier) if it is determined by the Government that the late receipt was due primarily to Government mishandling after receipt at the Government installation;

(3) Was sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee, not later than 5:00 P.M. at the place of mailing two working days prior to the date specified for receipt of bids. The term "working days" excludes weekends and U.S. Federal holidays; or

(4) Was transmitted through an electronic commerce method authorized by the solicitation and was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids.

(b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.

(c) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date or the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(d) The only acceptable evidence to establish the time of receipt at the Government installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.

(e) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph (c) of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(f) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

(g) Bids may be withdrawn by written notice or telegram (including mailgram) received at any time before the exact time set for receipt of bids. If the solicitation authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids subject to the conditions specified in the provision entitled "Facsimile Bids." A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identify of the person requesting withdrawal is established and the person signs a receipt for the bid.

(h) If an emergency or unanticipated event interrupts normal Government processes so as to cause postponement of the scheduled bid opening, and urgent Government requirements preclude amendment of the solicitation or other notice of an extension of the opening date, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

#### 7. PREPARATION OF BIDS - CONSTRUCTION (APR 1984) FAR 52.214-18.

(a) Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit prices for one or more items on various bases, including -

- (1) Lump sum bidding;
- (2) Alternate prices;
- (3) Units of construction; or
- (4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

8. NOT USED.

9. NOT USED.

#### 10. BIDDER'S QUALIFICATIONS.

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization,

financial resources, and plant available to be used in performing the work. The successful bidders will be required to submit his Workman's Compensation Experience Modification Rate (EMR) for the previous 3 years.

11. NOT USED

28 March 1998

12. BID GUARANTEE (SEP 1996) FARS 52.228-1 (Para. (a) - (e) only).

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, such as a bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(c) The amount of the bid guarantee shall be 20 percent of the bid price or \$3,000,000, whichever is less.

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.

(e) In the event the contract is terminated for default, the Bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(f) The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents. Bid bonds are not required for projects under \$100,000.

(g) Individual Sureties. See Paragraph 15.

20 March 1997

13. PERFORMANCE AND PAYMENT BONDS. After the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to the Government shall be furnished: a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A). The penal sums of such bonds will be as follows:

(a) Performance Bond. The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.

(b) Payment Bond.

(1) When the contract price is \$1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.

(2) When the contract price is in excess of \$1,000,000 but not more than \$5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(3) When the contract price is more than \$5,000,000 the penal sum shall be \$2,500,000.

(c) For rules covering the use of individual sureties see Paragraph 15. Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of contract performance.

14. NOT USED.

15. RULES FOR USE OF INDIVIDUAL SURETIES.

(a) One individual surety is adequate support for a bond, provided the unencumbered value of the assets pledged by that individual surety equal or exceed the amount of the bond. An offeror may submit up to three individual sureties for each bond, in which case the pledged assets when combined must equal or exceed the penal amount of the bond. Each individual surety must accept both joint and several liability to the extent of the penal amount of the bond.

(b) An individual surety may be accepted only if a security interest in acceptable assets is provided to the Government by the individual surety. The security interest shall be furnished with the bond, and may be provided by one or a combination of the following methods:

(1) An escrow account with a federally insured financial institution in the name of the contracting agency.

(2) A lien on real property, subject to restrictions contained herein.

(c) Acceptable assets include:

(1) Cash or certificates of deposit, or other cash equivalents with a federally insured financial institution;

(2) United States Government securities at market value;

(3) Stocks and bonds actively traded on a national U.S. security exchange with certificates issued in the name of the individual surety (these assets will be accepted at 90 percent of their 52 week low, as reflected at the time of submission of the bond);

(4) Real property owned in fee simple by the surety without any form of concurrent ownership (these assets will be accepted at 100 percent of the most current tax assessment value exclusive of encumbrances or 75 percent of the properties' unencumbered market value provided a current appraisal is furnished);

(5) Irrevocable letters of credit (ILC) issued by a federally insured financial institution in the name of the contracting agency and which identify the agency and solicitation or contract number for which the ILC is provided.

(d) Unacceptable assets include but are not limited to:

(1) Notes or accounts receivable;

(2) Foreign securities;

(3) Real property as follows:

a. Real property located outside the United States, its territories, or possessions.

b. Real property which is a principal residence of the surety.

c. Real property owned concurrently regardless of the form of co-tenancy except where all co-tenants agree to act jointly.

d. Life estates, leasehold estates, or future interests in real property.

(4) Personal property such as jewelry, furs, antiques;

(5) Stocks and bonds of the individual surety in a controlled, affiliated, or closely held concern of the Offeror/Contractor;

(6) Corporate assets (e.g., plant and equipment);

(7) Speculative assets (e.g., mineral rights);

(8) Letters of credit, except as provided in subparagraph c(5) above.

(e) With respect to the acceptance of real property, the individual surety shall provide:

(1) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice;

(2) Evidence of the amount due under any encumbrance shown in the evidence of title;

(3) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice.

(4) Failure to provide evidence that the lien has been properly recorded will render the offeror nonresponsible.

(f) An individual may be excluded from acting as individual surety on bonds for any of the following causes:

(1) Failure to fulfill the obligations under any bond.

(2) Failure to disclose all bond obligations.

(3) Misrepresentation of the value of available assets or outstanding liabilities.

(4) Any false or misleading statement, signature or representation on a bond or affidavit of individual suretyship.

(5) Any other cause affecting responsibility as a surety of such serious and compelling nature as may be determined to warrant exclusion.

An individual surety excluded pursuant to this subsection shall be included on the list entitled "Parties Excluded from Procurement Programs."

(g) Any bidder or offeror should carefully review these requirements which are set forth in Section 28 of the Federal Acquisition Regulations (FAR).

20 March 1997

16. SITE VISIT FAR (APR 1984) 52.237-1.

Offerors or quoters are urged and expected to inspect the site where services are to be performed and to satisfy themselves regarding all general and local conditions that may affect the cost of contract performance, to the extent that the information is reasonably obtainable. In no event shall failure to inspect the site constitute grounds for a claim after contract award. Site visits may be arranged during normal duty hours by contacting:

Paul Kara  
Resident Office  
New York District  
Building 5212  
Maryland Avenue  
Fort Dix, NJ 08640

22 Jan 99

17. REQUESTS FOR INFORMATION. Telephone inquiries relating to this procurement should be directed to the Louisville District, Corps of Engineers, as listed below: ORAL EXPLANATIONS OR INSTRUCTIONS GIVEN BEFORE THE AWARD OF A CONTRACT WILL NOT BE BINDING. SEE PARAGRAPH 5: "EXPLANATION TO PROSPECTIVE BIDDERS" FOR PROPER PROCEDURES.

Procurement of Plans  
& Specifications--Denise Gill.....502/582-6544  
Prospective Bidders may find the planholders list on the Internet at  
[http://www.lrl.usace.army.mil/ct/ct\\_pages.htm](http://www.lrl.usace.army.mil/ct/ct_pages.htm)

Technical Questions on Plans  
& Specifications -Harrison Fox .....502/582-6909  
Fax.....502/582-6763

18. LOCATION OF BID OPENING. Directions and map to the bid opening address are attached at the end of this section.

19. NOT USED.

20. NOT USED.

21. NOT USED.

22. NOT USED.

16 Feb 1999

23. INDUSTRY SMALL BUSINESS SIZE STANDARDS (JAN 1999) FAR 19.102.

23.1 General.

(a) The SBA establishes small business size standards on an industry-by-industry basis. (See 13 CFR 121.)

(b) Small business size standards are applied by--

(1) Classifying the product or service being acquired in the industry whose definition, as found in the Standard Industrial Classification (SIC) Manual, best describes the principal nature of the product or service being acquired.

(2) Identifying the size standard SBA established for that industry;  
and

(3) Specifying the size standard in the solicitation, so that offerors can appropriately represent themselves as small or large.

(c) For size standard purposes, a product or service shall be classified in only one industry, whose definition best describes the principal nature of the product or service being acquired even though for other purposes it could be classified in more than one.

(d) When acquiring a product or service that could be classified in two or more industries with different size standards, contracting officers shall apply the size standard for the industry accounting for the greatest percentage of the contract price.

(e) If a solicitation calls for more than one item and allows offers to be submitted on any or all of the items, an offeror must meet the size standard for each item it offers to furnish. If a solicitation calling for more than one item requires offers on all or none of the items, an offeror may qualify as a small business meeting the size standard for the item accounting for the greatest percentage of the total contract price.

(f) Any concern which submits a bid or offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is deemed to be a small business when it has no more than 500 employees, and---

(1) In the case of Government acquisitions set-aside for small businesses, such nonmanufacturer must furnish in the performance of the contract the product of a small business manufacturer or producer, which end product must be manufactured or produced in the United States. The term "nonmanufacturer" includes a concern which can manufacture or produce the product referred to in the specific acquisition but does not do so in connection with that acquisition. For size determination purposes there can be only one manufacturer of the end item being procured. The manufacturer of the end item being acquired is the concern which, with its own forces, transforms inorganic or organic substances including raw materials and/or miscellaneous parts or components into such end item. Whether a bidder on a particular acquisition is the manufacturer or a nonmanufacturer for the purpose of a size determination need not be consistent with whether such concern is or is not a manufacturer for the purpose of the Walsh-Healey Act.

(2) A concern which purchases items and packages them into a kit is considered to be a nonmanufacturer small business and can qualify as such for a given acquisition if it meets the size qualifications of a small nonmanufacturer for acquisition, and if more than 50 percent of the total value of the kit and its contents is accounted for by items manufactured by small business.

(3) For the purpose of receiving a Certificate of Competency on an unrestricted acquisition, a small business nonmanufacturer may furnish any domestically produced or manufactured product.

23.2 The industry size standards are set forth in the following table. The table column labeled "SIC" follows the standard industrial classification code as published by the Government in the Standard Industrial Classification Manual. The Manual is intended to cover the entire field of economic activities. It classifies and defines activities by industry categories and is the source used by SBA as a guide in defining industries for size standards. The number of employees or annual receipts indicates the maximum allowed for a concern, including its affiliates, to be considered small.

23.3 Size standards for construction and special trades.

A concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed \$17 million. However, if 75 percent or more of the work (in terms of dollar value) called for by the contract is

classified in one of the industries, subindustries, or classes of products listed in this paragraph, the concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed the size standard for that industry, subindustry, or class of products. (See Division C, "Contract Construction," of the SIC Manual).

Classification Code	Industry, Subindustry, or Class of Products	Size Standard*
---------------------	---	----------------

MAJOR GROUP 15--BUILDING CONSTRUCTION--GENERAL CONTRACTORS  
AND OPERATIVE BUILDERS

1521	General Contractors--Single-Family House	\$17.0
1522	General Contractors--Residential Buildings, Other Than Single-Family	17.0
1531	Operative Builders	17.0
1541	General Contractors--Industrial Buildings and Warehouses	17.0
1542	General Contractors--Nonresidential Buildings Other Than Industrial Buildings and Warehouse	17.0

MAJOR GROUP 16--CONSTRUCTION OTHER THAN BUILDING  
CONSTRUCTION--GENERAL CONTRACTORS

1611	Highway and Street Construction, Except Elevated Highway	17.0
1622	Bridge, Tunnel, and Elevated Highway Construction	17.0
1623	Water, Sewer, Pipe Line, Communication and Power Line Construction	17.0
1629	Heavy Construction, Except Dredging N.E.C.	17.0
1629	Dredging and Surface Cleanup Activities	13.5

MAJOR GROUP 17--CONSTRUCTION--SPECIAL TRADE  
CONTRACTORS

1711	Plumbing, heating (except electric), and air conditioning	\$7
1721	Painting, paperhanging, and decorating	7
1731	Electrical Work	7
1741	Masonry, stone setting, and other stonework	7
1742	Plastering, drywall, acoustical and insulation work	7
1743	Terrazzo, tile, marble, and mosaic work	7
1751	Carpentry Work	7
1752	Floor laying and other floorwork, not elsewhere classified	7
1761	Roofing, siding and sheet metal work	7
1771	Concrete work	7
1781	Water well drilling	7
1791	Structural steel erection	7
1793	Glass and glazing work	7
1794	Excavating and foundation work	7
1795	Wrecking and demolition work	7
1796	Installation or erection of building equipment, not elsewhere classified	7
1799	Special trade contractors, not elsewhere classified	7

\* (Average Annual Receipts) (Millions)

24. CONTRACT PRICES - BIDDING SCHEDULES (DEC 1991) DFARS 52.236-7008.

(a) The Government's payment for the items listed in the Bidding Schedule shall constitute full compensation to the Contractor for--

(1) Furnishing all plant, labor, equipment, appliances, and materials;  
and

(2) Performing all operations required to complete the work in conformity with the drawings and specifications.

(b) The Contractor shall include in the prices for the items in the Bidding Schedule all costs for work in the specifications, whether or not specifically listed in the Bidding Schedule.

2 Jan 96

25. ARITHMETIC DISCREPANCIES EFARS 52.214-5000.

(a) For the purpose of initial evaluations of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by the bidder:

- (1) Obviously misplaced decimal points will be corrected;
- (2) In case of discrepancy between unit prices and extended price, the unit price will govern;
- (3) Apparent errors in extension of unit prices will be corrected; and
- (4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

1 February 1995

26. WAGE RATES. The Wage Decisions of the Secretary of Labor are applicable to the work to be performed under this contract and are contained in SECTION 00800, SPECIAL CONTRACT REQUIREMENTS. Modifications are periodically made to the wage decisions. The complete modifications will be issued by amendment to the solicitation.

24 Sep 1998

27. MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS. The right is reserved, as the interest of the Government may require, to revise or amend the specifications and/or drawings prior to the date set for opening of bids. Such revisions and amendments, if any, will be announced by an amendment or amendments to this Invitation for Bids. Copies of such amendments as may be issued will be furnished to all prospective bidders. If the revisions and amendments are of a nature which require material changes in quantities or prices bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the Contracting Officer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.

24 Sep 1998

(1)28. NOTICE OF BUY AMERICAN ACT REQUIREMENTS - CONSTRUCTION MATERIALS. (MAY 1997) FAR 52.225-12

(a) Offerors are required to comply with the requirements of Federal Acquisition Regulation (FAR) clause 52.225-5, Buy American Act - Construction Materials, of this solicitation. The terms "construction material" and "domestic construction material," as used in this provision, have the meanings set forth in FAR clause 52.225-5.

(b) Offerors should request a determination regarding the inapplicability of the Buy American Act in time to allow determination before submission of offers. For evaluation of a request for a determination regarding the inapplicability of the requirements of the Buy American Act prior to the time set for receipt of offers, the information and applicable supporting data required by paragraphs (c) and (d) of FAR clause 52.225-5 shall be included in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act prior to submission of its offer, or has not received a response to a request made prior to submission of its offer, the information and supporting data shall be included in the offer.

(c) Evaluation of offers.

(1) For evaluation of offers, (unless agency regulations specify a higher percentage) the Government will add to the offered price 6 percent of the cost of any foreign construction material proposed for exception from the requirements of the Buy American Act based on claimed unreasonable cost of domestic construction materials in accordance with paragraph (b)(3)(i) of FAR clause 52.225-5.

(2) If the evaluation of offers results in a tie between an offer including such foreign construction material excepted on the basis of unreasonable cost, as evaluated, and an offer including solely domestic construction material or other foreign construction material listed in the solicitation at paragraph (b)(2) of FAR clause 52.225-5, or subsequently excepted in accordance with paragraphs (b)(3)(ii) or (iii) of FAR clause 52.225-5, award shall be made to the offeror that submitted the latter offer.

(d) Alternate offers.

(1) When an offer includes foreign construction material not listed by the Government in the solicitation at paragraph (b)(2) of FAR clause 52.225-5, offerors also may submit alternate offers base on use of equivalent domestic construction.

(2) If alternate offers are submitted, a separate Standard Form 142 shall be submitted for each alternate offer, and a separate price comparison table, prepared in accordance with paragraph (c) and (d) of FAR clause 52.225-5, shall be submitted for each offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception to apply.

(3) If the Government determines that a particular exception requested under paragraph (c) of FAR clause 52.225-5 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic construction material, and the offeror shall be required to furnish such domestic construction material.

(i) In sealed bid procurements, any offer based on use of that particular foreign construction material shall be rejected as nonresponsive.

(ii) In negotiated procurements, any offer based on use of that particular foreign construction material may not be accepted unless revised during negotiations.

29. LISTING OF EMPLOYMENT OPENINGS. Offerors should note that this solicitation includes a provision requiring the listing of employment openings with the local office of the State employment service system if the award is for \$10,000 or more.

22 June 1998

30. SUBMISSION OF INVOICES.

In accordance with Section 00010, Para. 24, submit invoices to:

Paul Kara  
 Resident Office  
 New York District  
 Building 5212  
 Maryland Avenue  
 Fort Dix, NJ 08640

16 Feb 1999

31. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999) FAR 52.222-23.

(a) The Offeror's attention is called to the EQUAL OPPORTUNITY and the AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION clauses of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

.....	
Goals for minority participation for each trade	Goals for female participation in each trade
	6.9%
Electricians	9.0 to 10.2%
Carpenters	27.6 to 32.0%
Steam Fitters	12.2 to 13.5%
Metal Lathers	24.6 to 25.6%
Painters	23.6 to 26.0%
Operating engineers	25.6 to 26.0%
Plumbers	12.0 to 14.5%
Iron workers (struct)	25.9 to 32.0%
Elevator constructors	5.5 to 6.5%
Bricklayers	13.4 to 15.5%
Asbestos workers	22.8 to 28.0%
Roofers	6.3 to 7.5%
Iron workers (ornamental)	22.4 to 23.0%
Cement masons	23.0 to 27.0%
Glaziers	16.0 to 20.0%
Plasterers	15.8 to 18.0%
Teamsters	22.0 to 22.5%
Boilermakers	13.0 to 15.5%
All others	16.4 to 17.5%

.....

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the Contractor performs construction work (whether or not it is Federal or Federally assisted) in a geographical area located outside the covered area, it shall apply the goals established for the geographical area where such work is actually performed. Goals are published periodically in the Federal

Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs (OFCCP) Office.

(c) The Contractor's compliance with Executive Order 11246 as amended and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity clause, specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction" and its efforts to meet prescribed goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary, for Federal Contract Compliance, U.S. Department of Labor within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the---

- (1) Name, address and telephone number of the subcontractor; (2) Employer's identification number of the subcontractor; (3) Estimated dollar amount of the subcontract;
- (4) Estimated starting and completion dates of the subcontract;

and

- (5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in the contract resulting from this Solicitation, the "covered area" is Burlington County, New Jersey, which includes the Philadelphia, PA economic area.

16 Feb 1999

32. SUBCONTRACTING PLANS FOR SMALL BUSINESS CONCERNS. Bidders are cautioned that compliance with CONTRACT CLAUSE: SMALL BUSINESS SUBCONTRACTING PLAN requires that the apparent low bidder, upon request by the Contracting Officer, submit a subcontracting plan for subcontracting with small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns. Bidders desiring assistance in developing a source list are encouraged to contact small business, HUBZone small business, small disadvantaged, and women-owned small business associations and appropriate Offices of Small and Disadvantaged Business Utilization, addresses which may be obtained from the District Labor Adviser, U.S. Army Engineer District, P.O. Box 59, Louisville, Kentucky 40201 (Telephone 502/582-5679).

33. NOT USED.

15 September 1995

34. MODIFICATION OF BIDS BY FACSIMILE. Bidders WILL NOT be allowed to modify their bids at any time by facsimile or teletype.

35. PAYMENT FOR BOND PREMIUMS. CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS provides that upon presentation of evidence of full payment, the Government will immediately reimburse the Contractor the cost of premiums for performance and payment bonds. This reimbursement amount is not in addition to the amount bid for the work covered by this Invitation for Bids, and bidders are cautioned to include the cost of such premiums in the bid items shown on the Bidding Schedule (or in the lump sum amount of the bid if no bid items are listed). If bond premiums are reimbursed under this clause, such reimbursed amount will be recovered by the Government from the progress payments made to the Contractor or, if no

progress payments are made, from the amount otherwise due the Contractor upon final payment.

36. NOT USED.

37. NOT USED.

38. SERVICE OF PROTEST (AUG 1996) FAR 52.233-2.

(a) Protests, as defined in Section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from:

Ms. Denise A. Bauer, Contracting Officer  
U.S. Army Engineer District, Louisville  
Corps of Engineers - ATTN: CEORLCT  
600 Dr. Martin Luther King Jr. Place, Room 821  
Louisville, Kentucky 40202-2230

(b) The copy of any protest shall be received in the office designated above on the same day a protest is filed with the GSBICA or within one day of filing a protest with the GAO.

39. COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (DEC 1991)  
DFARS 252.204-7001

(a) The Offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter CAGE before the number.

(b) If the Offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Services Center (DLSC). The Contracting Officer will--

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLSC; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

20 March 1997

40. DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (APR 1998) FAR 52.204-6.

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number is a nine-digit number assigned by Dun and Bradstreet Information Services.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

- (1) Company name.
- (2) Company address.
- (3) Company telephone number.

- (4) Line of business.
- (5) Chief executive officer/key manager.
- (6) Date the company was started.
- (7) Number of people employed by the company.
- (8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at <http://www.dnb.com/>. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at [globalinfo@mail.dnb.com](mailto:globalinfo@mail.dnb.com).

41. NOT USED.

20 March 1997

42. NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990) FAR 52.211-14.

42.1 Any contract awarded as a result of this solicitation will be a [ ] DX rated order; [X] DO-C2 rated order certified for national defense use under the Defense Priorities and Allocations System (DFARS) 15 CFR 700, and the Contractor will be required to follow all of the requirements of this regulation.

43. PRICE BASIS. Prices must be firm. Bids will not be considered which provide for subsequent increase in price.

24 Sep 1998

44. CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (AUG 1996) FAR 52.214-19.

(a) The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

(b) The Government may reject any or all bids, and waive informalities on minor irregularities in bids received.

(c) The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

(d) The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

45. NOT USED.

(1)46. AWARD TO SINGLE BIDDERS. Subject to the provisions contained herein, award shall be made to a single bidder. Bids must include unit prices for each item listed in order that bids may be properly evaluated. Failure to do this shall be cause for rejection of the entire bid. Bids shall be evaluated on the basis of the estimated quantities shown, and award shall be made to that responsible bidder whose total aggregate price is low, subject to the requirements of Para. 47 below.

47. NOT USED.

48. NOT USED.

49. NOT USED.

LOCATION OF BID OPENING. Bidders are provided the following information as a service by the government. The government cannot be held liable for street closures, traffic delays or other problems that may be encountered due to reliance upon the government's suggested routes to the Federal Building.

**Motorist coming from I-65 North:**

Immediately after crossing the Kennedy bridge, take exit I-64 West (St. Louis). Once in I-64, take the 9th street exit. Continue straight on 9th street for approximately seven blocks to Broadway (first major street with two-way traffic). Turn left on Broadway; go two blocks and turn left on 7th street (7th street is one-way north bound). Approximately 1/2 block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-65 South:**

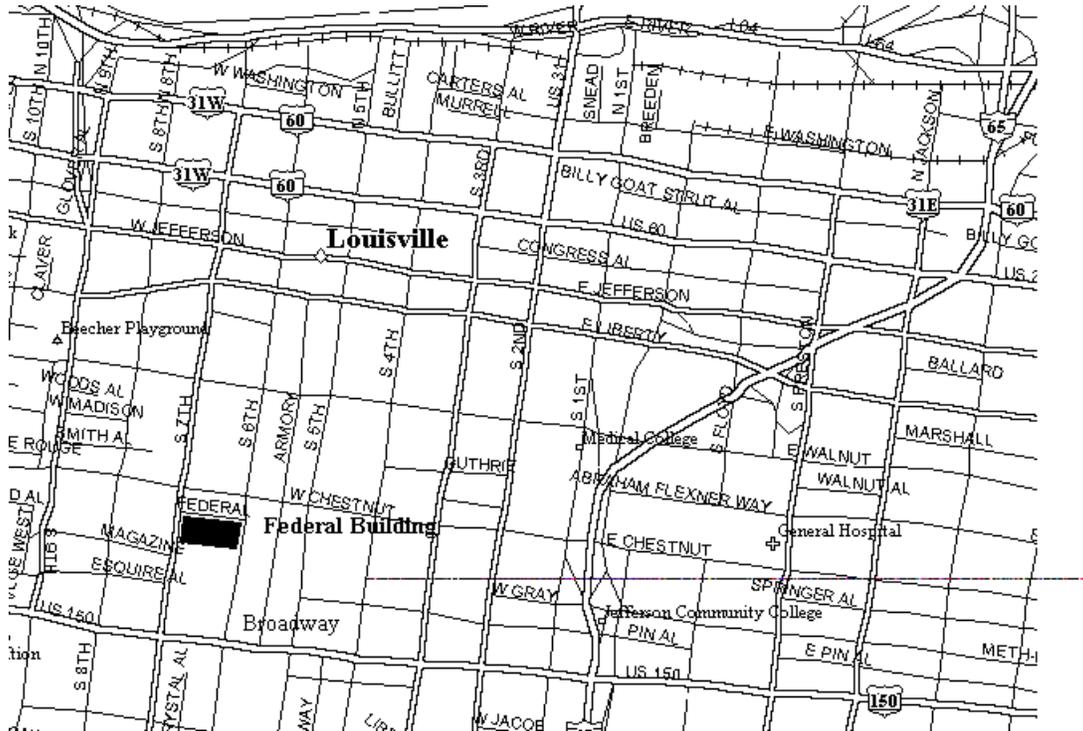
Take Broadway exit and turn left on Broadway (west bound) and continue to 7th street and turn right. Approximately 1/2 block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-64 East and West:**

Exit the 9th street exit. At the bottom of the ramp continue south down 9th street for approximately seven blocks until you come to Broadway (first major two way street). Turn left on Broadway and to two blocks and turn left on 7th street (7th street is one-way north bound). Approximately 1/2 block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-71:**

Follow routing for intersecting with I-64 and follow the instructions for I-64 motorists.



**BIDDER: READ CAREFULLY - CHECK ALL APPLICABLE BOXES**

**SECTION 00600**

**REPRESENTATIONS, CERTIFICATIONS, AND OTHER STATEMENTS OF BIDDER  
FOR SEALED BID CONSTRUCTION CONTRACTS**

**DATE OF OFFER:** \_\_\_\_\_ **DUNS NO.** \_\_\_\_\_

**SOLICITATION NO.** \_\_\_\_\_ **CAGE NO.** \_\_\_\_\_

**NAME AND ADDRESS OF OFFEROR:** \_\_\_\_\_

The offeror makes the following representations and certifications as part of the offer referenced above.

**1. CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985) FAR 52.203-2**

(a) The offeror certifies that--

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory--

(1) Is the person in the offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision \_\_\_\_\_ [*insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization*];

(ii) As an authorized agent, does certify that the principals name in subdivision (b)(2)(i) of this provision have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of provision)

## **2. CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991) FAR 52.203-11**

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(End of Provision)

**3. TAXPAYER IDENTIFICATION (OCT 1998) FAR 52.204-3**

**(a) Definitions.**

“Common parent,” as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Taxpayer Identification Number (TIN),” as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

**(d) Taxpayer Identification Number (TIN).**

- ] TIN: \_\_\_\_\_
- ] TIN has been applied for.
- ] TIN is not required because:
  - ] Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;
  - ] Offeror is an agency or instrumentality of a foreign government;
  - ] Offeror is an agency or instrumentality the Federal Government;

**(e) Type of Organization.**

- ] Sole proprietorship;
- ] Partnership;
- ] Corporate entity (not tax-exempt);
- ] Corporate entity (tax-exempt);
- ] Government entity (Federal, State, or local);
- ] Foreign government;
- ] International organization per 26 CFR 1.6049-4;
- ] Other \_\_\_\_\_

**(f) Common Parent.**

Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

Name and TIN of common parent:

Name \_\_\_\_\_ TIN \_\_\_\_\_  
 (End of provision)

**4. WOMEN-OWNED BUSINESS (OCT 1995) FAR 52.204-5**

(a) **Representation.** The offeror represents that it  is,  is not a women-owned business concern.

(b) **Definition.** “Women-owned business concern,” as used in this provision, means a concern which is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(End of provision)

**5. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (MAR 1996) FAR 52.209-5**

(a) (1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are  are not  presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have  have not , within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are  are not  presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has  has not , within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) “Principals,” for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

## **6. DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (SEP 1994) DFARS 252.209-7001**

### **(a) Definitions.**

As used in this provision--

(1) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405 (j)(i)(A)), to be a country the government of which has repeatedly provided support for acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means--

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

- (ii) Holding a management position in the firm, such as a director or officer;
- (iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;
- (iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or
- (v) Holding 50 percent or more of the indebtedness of a firm.

(b) **Prohibition on award.** In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) **Disclosure.** If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclose such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include--

- (1) Identification of each government holding a significant interest; and
  - (2) A description of the significant interest held by each government.
- (End of provision)

#### **7. COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (MAR 1998) DFARS 52.209-7003**

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 38 U.S.C. 4212(d) (i.e., the VETS-100 report required by Federal Acquisition Regulation clause 52.222-37, Employment Reports on Disabled Veterans and Veterans of the Vietnam Era), it has submitted the most recent report required by 38 U.S.C. 4212(d).

(End of provision)

#### **8. SMALL BUSINESS PROGRAM REPRESENTATIONS (OCT 1998) FAR 52.219-1 (ALTERNATE I) (OCT 1998)**

- (a) (1) The standard industrial classification (SIC) code for this acquisition is 1542.
  - (2) The small business size standard is \$17.0 million.
  - (3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.
- (b) **Representations.** (1) The offeror represents as part of its offer that it [ ] is, [ ] is not a small business concern.

(2) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it [ ] is, [ ] is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it [ ] is [ ] is not a women-owned small business concern.

(4) (Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision). [The offeror shall check the category in which its ownership falls];

\_\_\_\_\_ Black American

\_\_\_\_\_ Hispanic American

\_\_\_\_\_ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

\_\_\_\_\_ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

\_\_\_\_\_ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

\_\_\_\_\_ Individual/concern, other than one of the preceding.

**(c) Definitions.**

“Small business concern,” as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

“Woman-owned small business concern,” as used in this provision, means a small business concern--

(1) Which is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

**(d) Notice.** (1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm’s status as a small or small disadvantaged business concern in order to obtain a contract to be awarded under the preference programs

established pursuant to sections 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

- (i) Be punished by imposition of fine, imprisonment, or both;
  - (ii) Be subject to administrative remedies, including suspension and debarment; and
  - (iii) Be ineligible for participation in programs conducted under the authority of the Act.
- (End of provision)

#### **9. EQUAL LOW BIDS (OCT 1995) FAR 52.219-2**

(a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

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(c) Failure to identify the labor surplus areas as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

(End of provision)

#### **10. SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (JAN 1997) FAR 52.219-19**

(a) **Definition.** "Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the standard industrial classification code assigned to a contracting opportunity.

(b) **(Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.)** The Offeror [ ] is, [ ] is not an emerging small business.

(c) **(Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)** Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts - see paragraph 11(a) (2) Small Business Program Representations).

Number of Employees	<b>(Construction Solicitations)</b> Avg. Annual Gross Revenues
_____ 50 or fewer	_____ \$1 million or less
_____ 51 - 100	_____ \$1,000,001 - \$2 million
_____ 101 -250	_____ \$2,000,001 - \$3.5 million
_____ 251 - 500	_____ \$3,500,001 - \$5 million
_____ 501 - 750	_____ \$5,000,001 - \$10 million
_____ 751 - 1,000	_____ \$10,000,001 - \$17 million
_____ Over 1,000	_____ Over \$17 million

(End of provision)

**11. PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999) FAR 52.222-22**

The offeror represents that--

(a) It [ ] has [ ] has not, participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation;

(b) It [ ] has, [ ] has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of Provision)

**12. CLEAN AIR AND WATER CERTIFICATION (APR 1984) FAR 52.223-1**

The Offeror certifies that--

(a) Any facility to be used in the performance of this proposed contract [ ] is, [ ] is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the EPA, indicating that any facility that the Offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

(End of Provision)

**13. CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 1996)  
FAR 52.223-13**

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8,1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facilities is exempt for at least one of the following reasons: *(Check each block that is applicable.)*

- (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);
- (ii) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);
- (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);
- (iv) The facility does not fall within the Standard Industrial Classification Code (SIC) designations 20 through 39 as set forth in section 19.102 of the Federal Acquisition Regulation; or

(v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of provision)

(End of Section 00605)

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120	52.228-12	PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995)
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121	252.232-7009	PAYMENT BY ELECTRONIC FUNDS TRANSFER (CCR) (JUN 1998)
(Reference 232.1103)		
122	52.236-26	PRECONSTRUCTION CONFERENCE (FEB 1995)
123	252.242-7000	POSTAWARD CONFERENCE (DEC 1991)
124	252.7002	REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998)
125	252.7001	REPORTS OF GOVERNMENT PROPERTY (MAY 1994)

## SECTION 00700

## CONTRACT CLAUSES

## 1 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at these addresses:

<http://www.hnd.usace.army.mil/techinfo/index.htm>

## 2 52.3-4001 INFORMATION REGARDING BID, PERFORMANCE, AND PAYMENT BONDS

(a) Bid Bonds: (Applicable only if bid is \$25,000 or greater.) Each bidder shall submit with its bid a Bid Bond (Standard Form 24) with good and sufficient surety or sureties acceptable to the Government, or other security as provided in Section I - "BID BOND", in the form of twenty percent (20%) of the bid price or \$3,000,000, whichever is less.

The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may expressed in dollars and cents.

(b) Performance and Payment Bonds: (Applicable only if the contract is \$25,000 or greater.) Within 10 calendar days after award, a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A), each with good and sufficient surety or sureties acceptable to the Government, shall be furnished. The penal sums of such bonds will be as follows:

(1) Performance Bond: The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price. The performance bond shall specifically provide coverage for taxes imposed by the United States which are collected, deducted, or withheld from wages paid by the Contractor in carrying out the contract with respect to which such bond is furnished.

(2) Payment Bond:

(i) When the contract price is 1,000,000 or less, the penal sum will be fifty (50%) of the contract price.

(ii) When the contract price is in excess of \$1,000,000 but less than \$5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(iii) When the contract price is more than \$5,000,000, the penal sum shall be \$2,500,000.

- 3 52.201-7000  
CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)  
(Reference 01.602-70)
- 4 52.202-1 IDEFINITIONS (OCT 1995)--ALTERNATE I (APR 1984)  
(Reference 2.201)
- 5 52.203-3 GRATUITIES (APR 1984)  
(Reference 3.202)
- 6 52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)  
(Reference 3.404)

- 7 52.203-7 ANTI-KICKBACK PROCEDURES (JUL 1995)  
(Reference 3.502-3)
- 8 52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN  
1997)  
(Reference 3.104-9(b))
- 9 52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL  
TRANSACTIONS (JUN  
1997)  
(Reference 3.808(b))
- 10 52.204-1 APPROVAL OF CONTRACT (DEC 1989)

This contract is subject to the written approval of Contracting Officer  
and shall not be binding until so approved.

(End of clause)

- 11 52.203-7001  
SPECIAL PROHIBITION ON EMPLOYMENT (JUN 1997)  
(Reference 03.570-5)
- 12 52.203-7002  
DISPLAY OF DOD HOTLINE POSTER (DEC 1991)  
(Reference 03.7002)
- 13 52.204-2 SECURITY REQUIREMENTS (AUG 1996)  
(Reference 4.404(a))
- 14 52.204-4 PRINTING/COPYING DOUBLE-SIDED ON RECYCLED PAPER (JUN 1996)  
(Reference 4.304)
- 15 52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH  
CONTRACTORS  
DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995)  
(Reference 9.409(b))
- 16 52.211-1 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF  
FEDERAL  
SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (JUN  
1997)  
(Reference 11.204(a))
- 17 52.211-2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF  
SPECIFICATIONS  
AND STANDARDS (DODISS) (JUN 1997)  
(Reference 11.204(b))
- 18 52.211-16 VARIATION IN QUANTITY (APR 1984)  
(Reference 11.703(a))
- 19 NOT USED.
- 20 52.228-7004  
BONDS OR OTHER SECURITY (DEC 1991)  
(Reference 28.170)
- 21 NOT USED.
- 22 NOT USED.
- 23 NOT USED.
- 24 52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (JAN 1999)  
(Reference 19.708(a))
- 25 NOT USED.
- 26 52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996)  
(Reference 19.508(e))
- 27 NOT USED.

28 52.222-1 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997)  
(Reference 22.103-5(a))

29 52.222-3 CONVICT LABOR (AUG 1996)  
(Reference 22.202)

30 52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME  
COMPENSATION  
(JUL 1995)  
(Reference 22.305)

31 52.222-6 DAVIS-BACON ACT (FEB 1995)  
(Reference 22.407(a)(1))

32 52.222-7 WITHHOLDING OF FUNDS (FEB 1988)  
(Reference 22.407(a)(2))

33 52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)  
(Reference 22.407(a)(3))

34 52.222-9 APPRENTICES AND TRAINEES (FEB 1988)  
(Reference 22.407(a)(4))

35 52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)  
(Reference 22.407(a)(5))

36 52.222-11 SUBCONTRACTS (LABOR STANDARDS) (FEB 1988)  
(Reference 22.407(a)(6))

37 52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)  
(Reference 22.407(a)(7))

38 52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB  
1988)  
(Reference 22.407(a)(8))

39 52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)  
(Reference 22.407(a)(9))

40 52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)  
(Reference 22.407(a)(1))

41 52.222-26 EQUAL OPPORTUNITY (APR 1984)  
(Reference 22.810(e))

42 52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION  
(APR 1984)  
(Reference 22.810(f))

43 52.222-35 AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE  
VIETNAM  
ERA (APR 1998)  
(Reference 22.1308)

44 52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)  
(Reference 22.1408(a))

45 52.222-37 EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE  
VIETNAM ERA (JAN 1999)  
(Reference 22.1308(b))

46 52.223-2 CLEAN AIR AND WATER (APR 1984)  
(Reference 23.105(b))

47 52.223-6 DRUG-FREE WORKPLACE (JAN 1997)  
(Reference 23.505(b))

48 52.223-7004  
DRUG-FREE WORK FORCE (SEP 1988)  
(Reference 23.570-4)

49 52.225-5 BUY AMERICAN ACT--CONSTRUCTION MATERIALS (JUN 1997)  
(Reference 25.207(a))

50 NOT USED.

51 52.225-11 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (OCT 1996)  
(Reference 25.702)

52 52.225-7002  
QUALIFYING COUNTRY SOURCES AS SUBCONTRACTORS (DEC 1991)  
(Reference 25.109-70(a))

53 52.225-7003

INFORMATION FOR DUTY-FREE ENTRY EVALUATION (MAR 1998)  
(Reference 25.605-70(d))

54 52.225-7031  
SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992)  
(Reference 25.770-5)

55 52.227-1  
AUTHORIZATION AND CONSENT (JUL 1995)  
(Reference 27.201-2(a))

56 52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT  
INFRINGEMENT  
(AUG 1996)  
(Reference 27.202-2)

57 52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)  
(Reference 27.203-5)

58 52.227-7003  
TERMINATION (AUG 1984)  
(Reference 27.7009-2(c))

59 52.227-7018  
RIGHTS IN NONCOMMERCIAL TECHNICAL DATA AND COMPUTER SOFTWARE--  
SMALL  
BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM (JUN 1995)  
(Reference 27.7104(a))

60 NOT USED.

61 52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)  
(Reference 28.106-4(a))

62 52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997)  
(Reference 28.310)

63 52.228-11 PLEDGES OF ASSETS (FEB 1992)  
(Reference 28.203-6)

64 52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)  
(Reference 29.401-3)

65 52.231-7000  
SUPPLEMENTAL COST PRINCIPLES (DEC 1991)  
(Reference 31.100-70)

66 52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997)  
(Reference 32.111(a)(5))

67 52.232-17 INTEREST (JUN 1996)  
(Reference 32.617(a)&())

68 52.232-23I ASSIGNMENT OF CLAIMS (JAN 1986) (Alternate I) (Apr 1984)  
(Reference 32.806(a)(1))

69 52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JUN 1997)  
(Reference 32.908(b))

70 52.233-1 DISPUTES (DEC 1998)  
(Reference 33.215)

71 NOT USED

72 52.236-1 PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984)  
(Reference 36.501(b))

73 52.236-2 DIFFERING SITE CONDITIONS (APR 1984)  
(Reference 36.502)

74 52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)  
(Reference 36.503)

75 52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)  
(Reference 36.505)

76 52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)  
(Reference 36.506)

77 52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)  
(Reference 36.507)

78 52.236-8 OTHER CONTRACTS (APR 1984)  
(Reference 36.508)

- 79 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT,  
UTILITIES, AND  
IMPROVEMENTS (APR 1984)  
(Reference 36.509)
- 80 52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)  
(Reference 36.510)
- 81 52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)  
(Reference 36.511)
- 82 52.236-12 CLEANING UP (APR 1984)  
(Reference 36.512)
- 83 52.236-13 ACCIDENT PREVENTION (NOV 1991)  
(Reference 36.513(a))
- 84 52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)  
(Reference 36.515)
- 85 52.236-17 LAYOUT OF WORK (APR 1984)  
(Reference 36.517)
- 86 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)  
(Reference 36.521)
- 87 52.236-7000  
MODIFICATION PROPOSALS--PRICE BREAKDOWN (DEC 1991)  
(Reference 36.570(a))
- 88 52.236-7004 PAYMENT FOR MOBILIZATION AND DEMOBILIZATION (DEC 1991)

(a) The Government will pay all costs for the mobilization and demobilization of all of the Contractor's plant and equipment at the contract lump sum price for this item.

(1) 60 percent of the lump sum price upon completion of the Contractor's mobilization at the work site.

(2) The remaining 40 percent upon completion of demobilization.

(b) The Contracting Officer may require the Contractor to furnish cost data to justify this portion of the bid if the Contracting Officer believes that the percentages in paragraphs (a)(1) and (2) of this clause do not bear a reasonable relation to the cost of the work in this contract.

(1) Failure to justify such price to the satisfaction of the Contracting Officer will result in payment, as determined by the Contracting Officer, of--

(i) Actual mobilization costs at completion of mobilization;

(ii) Actual demobilization costs at completion of demobilization; and

(iii) The remainder of this item in the final payment under this contract.

(2) The Contracting Officer's determination of the actual costs in paragraph (b)(1) of this clause is not subject to appeal.

(End of clause)

- 89 52.236-7001 CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (DEC 1991)

(a) The Government--

(1) Will provide the Contractor, without charge, five sets (five unless otherwise specified) of large-scale contract drawings and specifications except publications incorporated into the technical provisions by reference;

(2) Will furnish additional sets on request, for the cost of reproduction; and

(3) May, at its option, furnish the Contractor one set of reproducible, or half-size drawings, in lieu of the drawings in paragraph (a)(1) of this clause.

(b) The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the

work;

(3) Promptly notify the Contracting Officer of any discrepancies; and

(4) Be responsible for any errors which might have been avoided by complying with this paragraph (b).

(c) Large scale drawings shall, in general, govern small scale drawings. Figures marked on drawings shall, in general, be followed in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

Title	File	and	Drawing No.
See 0800-9	page 0800-3.		
(End of clause)			

- 90 52.236-7005 AIRFIELD SAFETY PRECAUTIONS (DEC 1991)  
(Reference 36.570(b)(3))
- 91 52.242-13 BANKRUPTCY (JUL 1995)  
(Reference 42.903)
- 92 52.243-4 CHANGES (AUG 1987)  
(Reference 43.205(d))
- 93 52.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)  
(Reference 43.205-71)
- 94 52.244-1 SUBCONTRACTS (FIXED-PRICE CONTRACTS) (OCT 1997)  
(Reference 44.204)
- 95 52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS AND COMMERCIAL COMPONENTS  
(APR 1998)  
(Reference 44.403)
- 96 52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989)  
(Reference 45.106(b)(1))
- 97 52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)  
(Reference 46.312)
- 98 52.246-21 I WARRANTY OF CONSTRUCTION (MAR 1994)--ALTERNATE I (APR 1984)  
(Reference 46.710(e)(2))
- 99 52.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (NOV 1995)  
(Reference 47.573(b))
- 100 52.247-7024 NOTIFICATION OF TRANSPORTATION OF SUPPLIES BY SEA (NOV 1995)  
(Reference 47.573(c))
- 101 52.248-3 VALUE ENGINEERING--CONSTRUCTION (MAR 1989)  
(Reference 48.202)
- 102 52.249-2 ITERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE)  
(SEP 1996)--  
ALTERNATE I (SEP 1996)  
(Reference 49.502(b)(1))
- 103 52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)  
(Reference 49.504(c)(1))
- 104 52.252-6 AUTHORIZED DEVIATIONS IN CLAUSES (APR 1984)

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is

indicated by the addition of "(DEVIATION)" after the date of the clause.

(b) The use in this solicitation or contract of any N/A (48 CFR N/A ) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of clause)

(NM)

- 105 52.253-1 COMPUTER GENERATED FORMS (JAN 1991)  
(Reference 53.111)
- 106 52.214-35 SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991)  
(Reference 14.201-6y &)
- 107 52.214-34 SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991)  
(Reference 14.201-6x &)
- 108 52.3-4002 APPLICABILITY OF COMPLETE WAGE RATE DECISION

Read the following in conjunction with the Wage Rates:

In addition to the wages rates in this solicitation, the complete decision of the Secretary of Labor contains wage rates for other classes of laborers and mechanics. Because it does not appear that the work called for by this solicitation will require the use of such other classes, the wage rates applicable to them have not been reprinted herein. However, if any such classes of laborers or mechanics actually are employed to perform work under the contract resulting from this solicitation, payment will be required as specified in the clauses entitled "Davis-Bacon Act" at Wage rates contained in the completed decision of the Secretary of Labor. Offerors desiring the complete decision may request it from the Contracting Officer.

- 109 52.0-4000 EFARS 52.202-10001 DEFINITIONS.

(a) The term "head of the agency" or "Secretary" as used herein means the Secretary of the Army; and the term "his duly authorized representative" means the Chief of Engineers, Department of the Army, or an individual or board designated by him.

(b) The agency board of contract appeals having jurisdiction over all appeals from final decisions of the Contracting Officer under the Contract Disputes Act of 1978 is the Corps of Engineers Board of Contract Appeals, Office of the Chief of Engineers, Pulaski Building, 20 Massachusetts Avenue, N.W., Washington, D.C. 20314-1000.

- 110 52.242-7000 POSTAWARD CONFERENCE (DEC 1991)  
(Reference 42.570)

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## SECTION 00800

### SPECIAL CONTRACT REQUIREMENTS

2 January 1996

1. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984)

a. FAR 52.211-10. The Contractor shall be required to commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, prosecute said work diligently, and complete the entire work ready for use not later than 540 calendar days after date of receipt of notice to proceed. The time stated for completion shall include as-built drawings, O&M manuals, operational tests/reports/training/instructions, equipment lists, and final cleanup of the premises.

b. Location: The project is located at Fort Dix, New Jersey.

c. The Contractor shall furnish all labor, materials, equipment, and services (except those furnished by the Government) for the following work: Ammunition Supply Point and site improvements.

d. All work shall be in accordance with the drawings and specifications or instructions attached hereto and made a part thereof, or to be furnished hereafter by the Contracting Officer and subject, in every detail, to his supervision, direction, and instructions.

e. Magnitude of Construction Project: The estimated value of the proposed work is between \$5,000,000 TO \$10,000,000.

### 2. LIQUIDATED DAMAGES – CONSTRUCTION

a. If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of \$365.00 for each day of delay.

b. If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

c. If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

### 3. EQUAL OPPORTUNITY PREAWARD CLEARANCE OF SUBCONTRACTORS (APR 1984)

Notwithstanding the clause of this contract entitled “Subcontracts”, the Contractor shall not enter into a first-tier subcontract for an estimated or actual amount of \$1 million or more without obtaining in writing from the Contracting Officer a clearance that the proposed subcontractor is in compliance with the equal opportunity requirements and therefore is eligible for award. (FAR 52.222-28)

#### 4. INSURANCE – WORK ON A GOVERNMENT INSTALLATION

a. The Contractor shall procure and maintain during the entire period of his performance under this contract the following minimum insurance:

(1) General Liability Insurance (Comprehensive form of policy):

Bodily Injury Liability - \$500,000 per occurrence.

(2) Automobile Liability Insurance (Comprehensive form of policy):

Bodily Injury Liability - \$200,000 per person and \$500,000 per accident.

Property Damage Liability - \$20,000 per accident.

(3) Workmen’s Compensation and Employer’s Liability Insurance:

Compliance with applicable workmen’s compensation and occupational disease statutes is required. Employer’s liability coverage in the minimum amount of \$100,000 is also required.

b. Prior to the commencement of work hereunder, the Contractor shall furnish to the Contracting Officer a certificate or statement of the above required insurance. The policies evidencing required insurance shall contain an endorsement to the effect that cancellation or any material change in the policies adversely affecting the interests of the Government in such insurance shall not be effective for such a period as may be prescribed by the laws of the State in which this contract is to be performed and in no event less than thirty (30) days after written notice thereof to the Contracting Officer.

c. The Contractor agrees to insert the substances of this clause, including this paragraph c., in all subcontracts hereunder.

#### 5. PERFORMANCE OF WORK BY THE CONTRACTOR (1984 APR)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least twenty (20) percent of the total amount of work to be performed under the contract. This percentage may be reduced by supplemental agreement to this

contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government. (FAR 52.236-1)

## 6. CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in 4 copies. Each certificates shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certification apply. Copies of laboratory tests reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfying material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements. (ECI 7-670.3)

## 7. IMPLEMENTING GUARANTEES

At any time subsequent to the acceptance by the Government of a completed installation under this contract, which installation is required to be covered by a specific guarantee under the terms of the various sections in the TECHNICAL PROVISIONS, the Base Commander will be an authorized party for the purpose of implementing the provisions of such guarantees in behalf of the Government.

## 8. BID GUARANTEE

See Contract clause entitled BID GUARANTEE in Section 00100 INSTRUCTIONS FOR SEALED BID CONTRACTS

## 9. CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS

See contract clause entitled CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS in Section 00700 CONTRACT CLAUSES. For a listing of the contract drawings see drawing Sheet X1.2.

## 10. RECORD DRAWINGS

a. General: The Contractor will maintain as-built drawings during the construction and will develop final record drawings at the completion of individual facilities.

b. Computer-Aided Drafting (CAD): Microstation CADD files are available for the project and in addition to all other requirements indicated herein, the Contractor shall be required to update the Computer-Aided Drafting (CAD) record using Microstation

CADD only for the project. If available the CAD record will be presented to the Contractor in addition to the mylar reproducible drawings after the approval of progress prints as indicated in paragraph "Preliminary Submittal", below. The Contractor will update the CAD record identical to the final as-built drawings, and will return the CAD record to the Contracting Officer's representatives with the same requirements and late penalty as indicated in paragraph "Final Requirements", below. Scanned drawings will not be acceptable. All other requirements indicated herein will still apply. The Contractor may use the updated CAD record to print blue-line or mylar drawings as required.

c. Progress As-built Prints: The Contractor shall mark up one set of paper prints to Show as-built construction conditions. These as-built prints shall be kept current and available on the job site at all times. All changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accordingly and neatly recorded as they occur by means of details and notes. The as-built prints will be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. The prints shall show the following information, but not limited thereto:

(1) The location and description of any utility lines, valves, or other installations of any kind within the construction area. The location includes dimensions to permanent features.

(2) The location and dimensions of any changes with the building and structure.

(3) Correct grade or alignment of roads, structures or utilities if any changes were made from the contract plans.

(4) Correct elevations if changes were made in site grading

(5) Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including but not limited to fabricated, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

(6) The topography and grades of all drainage installed or affected as part of the project construction.

(7) All changes, which result from contract modifications.

(8) Where contract drawings or specifications allow options, only the option selected for construction shall be shown on the as-built prints.

(9) All amendments to the contract drawings issued during the solicitation period shall be posted on the as-built drawings.

d. Preliminary Submittal: The Contractor shall prepare two copies of progress prints and these shall be delivered to the Contracting Officer at the time of final inspection of individual facilities for his review and approval. These as-built prints shall be neat, legible and accurate. Upon approval, one copy of the as-built prints will be returned to the Contractor for use in preparation of final as-built drawings. Upon review, if the drawings are found to contain errors and/or omission, they shall be returned to the Contractor for corrections and return of the as-built prints to the Contracting Officer within ten (10) calendar days.

e. Record Drawing Preparation: After approval of the progress as-built prints, the mylar drawings shall be modified as may be necessary to correctly show all the features of the project as it has been constructed by bringing the contract set into agreement with the approved as-built prints, adding such additional drawings as may be necessary. The Contractor shall be responsible for the protection and safety thereof until returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at his expense.

(1) Only personnel proficient in the preparation of engineering drawings to standards satisfactory and acceptable to the Government shall be employed to modify the mylar reproduction drawings or prepare additional new drawings. All additions and corrections to the contract drawings shall be neat, clean and legible, and shall match the adjacent line work and/or lettering being annotated in type, density, size and style. All drafting work shall be done using the same medium (pencil, plastic lead or ink) that was employed on the original contract drawings and with graphic lead on paper base material. The Contracting Officer will review all record drawings for accuracy and conformance to the above specified drafting standards. The Contractor shall make all corrections, changes, additions and deleting required to meet these standards. The title block to be used for any new as-built drawings shall be similar to that used on the original contract drawings.

(2) When final revisions have been completed, each drawing shall be lettered or stamped with the words "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in lettering at least 3/16" high. All original contract drawings shall be marked either "s-Built" drawing denoting no revision on the sheet or "Revised As-Built" denoting one or more revisions. All revisions to the original contract drawings will be dated in the revision block.

f. Final Requirements: After receipt by the Contractor of the approved as-built prints and the mylar reproducible drawings, the Contractor will make final record drawings submitted within 30 days. The submittal shall consist of the completed record drawings, two blue line prints of these drawings and the return of the approved marked-up as-built prints. They shall be complete in all details. All paper prints and reproducible

drawings will become property of the Government upon final approval. Failure to submit as-built drawings and final record drawings as required herein shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of the final record drawings shall be accomplished before final payment is made to the Contractor.

g. Beneficial Occupancy Drawings: If the Government accepts beneficial occupancy of a facility, and the Contractor is unable to provide the final record drawings within 45 days after the date of beneficial occupancy, the Contractor shall provide paper sepias for that facility. The paper sepias shall incorporate all changes to as-built drawings made up to the time of beneficial occupancy. Contractor is still obligated to comply with "Final Requirements" paragraph above.

h. Payment: No separate payment will be made for the as-built and record drawings required under this contract whether or not CAD record is updated, and all costs in connection therewith shall be considered a subsidiary obligation of the Contractor.

## 11. DESIGNATION OF PROPERTY ADMINISTRATOR

The Chief, Property and Accounting Section, U.S. Army Engineer District, New York, Federal Building, 26 Federal Plaza, New York, N.Y. 10278-0090 is designated as Property Administrator, in connection with this contract.

## 12. PHYSICAL DATA

Information and data furnished or referred to below are furnished for the Contractor's information. However, it is expressly understood that the Government will not be responsible for any interpretation or conclusion drawn therefrom by the Contractor. (FAR 52.236-4)

a. Weather Conditions: Climatological data determined from records of the U.S. Weather Bureau Station,

Mean Annual Temperature: 35 degrees F

Mean Annual Precipitation: 40 inches

See also paragraph entitled TIME EXTENSIONS FOR UNUSUALLY SEVER WEATHER.

b. Transportation Facilities:

(1) Highways and Roads: Roads within the military reservation proposed to be used by the Contractor, shall be subject to prior approval of the Contracting Officer and such roads, if used, shall be maintained throughout construction and shall be restored to as good condition as existed prior to their use. Any such temporary construction shall

be restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

### 13 PRICING OF ADJUSTMENTS

When costs are a factor in any determination of a contract price adjustment pursuant to the Changes clause or any other clause of this contract, such costs shall be in accordance with Part 31 of the Federal Acquisition Regulation and DFARS 52.215-7000 (APR 1985) as follows: In determining whether a pricing adjustment is expected to exceed \$100,000, the term "pricing adjustment" shall mean "the aggregate increases and /or decreases in cost plus applicable profits."

### 14 PAYMENT FOR MATERIALS DELIVERED OFF-SITE

Pursuant to the Contract Clause in this contract titled "Payment Under Fixed-Price Construction Contracts", materials delivered to the Contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the Contract Clauses are fulfilled. Payment for items delivered to locations other than the work site will be limited to those materials which have been approved, if required by the technical provisions; those materials which have been fabricated to the point where they are identifiable to an item of work required under this contract. Such payment will be made only after receipt of paid or receipted invoices or invoices with cancelled check showing title to the items in the prime contractor and including the value of materials and labor incorporated into the item.

### 15 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

a. Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractors at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region 1. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiation shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

(\* This manual can be ordered from the Government Printing office by calling telephone number (202) 783-3238. There is a charge for the manual.)

b. Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36 substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-

leaseback arrangements will be determined using the schedule except that rental costs leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

c. When actual equipment costs are proposed and the total amount of the pricing action is over \$25,000, cost or pricing data shall be submitted on Standard Form 1411, "Contract Pricing Proposal Cover Sheet." By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

## 16 ALTERATIONS IN CONTRACT (APR 1984)

Portions of this contract are altered as follows:

Add the following sentence to paragraph "g" of basic contract clause, SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (1984 APR):

"Upon completing the work under this contract, the Contractor shall furnish a complete set of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the equipment is completed and accepted." Alt.1 (APR 1984) (FAR 52.236-21) (7-602.54 (b) (1) OCT 1976)

## 17 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984)

a. The Government shall make all reasonable amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

b. The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all temporary connections, distribution lines, meters and associated paraphernalia. (FAR 52.235-14)

18 SALVAGE MATERIALS AND EQUIPMENT

The Contractor shall maintain adequate property control records for all materials or equipment specified to be salvaged. These records may be in accordance with the Contractor’s system of property control, if approved by the property administrator. The Contractor shall be responsible for the adequate storage and protection of all salvaged materials and equipment and shall replace, at no cost to the Government, all salvage materials and equipment which are broken or damaged during salvage operations as the result of his negligence, or while in his care. (DoD FAR Supplement 52.236-7005)

19. IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY (APR 1984)

a. The Government will furnish to the Contractor the property identified in the Schedule to be incorporated or installed into the work or used in performing the contract. The listed property will be furnished f.o.b. railroad cars at the place specified in the contract Schedule or f.o.b. truck at the project site. The Contractor is required to accept delivery, pay any demurrage or detention charges, and unload and transport the property to the job site at its own expense. When the property is delivered, the Contractor shall verify its quantity and condition and acknowledge receipt in writing to the Contracting Officer. The Contractor shall also report in writing to the Contracting Officer within 24 hours of delivery any damage to or shortage of the property as received. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated in this contract.

b. Each item of property to be furnished under this clause shall be identified in the Schedule by quantity, item and description. (FAR 52.245-3)

<u>Item No.</u>	<u>Description</u>	<u>Quantity</u>
	Bronze Minuteman Plaque	1

20 CONSTRUCTION PROJECT SIGNS

The Contractor shall construct two signs; one for project identification and the other to show on-the-job safety performance.

a. Sample sign drawings together with mounting and fabrication details are provided at the end of this section. The signs shall be erected as soon as possible and within 15 calendar days after the date of Notice to Proceed.

b. The two signs are to be displayed side by side and mounted for reading by passing viewers. Exact placement location will be designated by the Contracting Officer.

c. Panels are fabricated using HDO (High-Density Overlay) plywood with dimensional lumber uprights and bracing. The sign faces are non-reflective vinyl.

d. All legends are to be die-cut or computer-out in the sizes and type-faces specified and applied to the white panel background following the graphic formats shown on the attached sheets. The Communications Red panel on the left side of the construction project sign with Corps signature (reverse version) is screen printed onto the white background.

e. No separate payment will be made for erecting and maintaining the signs and all costs in connection therewith will be considered the obligation of the Contractor. Upon completion of the project, the Contractor shall remove the signs from the work area.

## 21 LABOR SURPLUS AREA EXPENDITURE REQUIREMENTS (JUL 1978)

a. The site of the construction work is located in an area determined by the Secretary of Labor to be a Labor surplus Area. Accordingly the Contractor hereby agrees to perform a substantial portion of the contract work in this or in any other labor surplus area. "Substantial portion" means the aggregate costs that will be incurred by the Contractor and his first-tier subcontractors and suppliers, on account of manufacturing, production, or services performed in this or any labor surplus area, and the costs that will be incurred by second-tier and lower-tier subcontractors on the construction site will exceed fifty percent (50%) of the price of this contract.

b. Upon request, the Contractor shall furnish to the Contracting Officer data to substantiate that this obligation is satisfied.

c. The Contracting Officer will furnish upon request a list of labor surplus areas.

## 22 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

1. This provision specifies the procedure for determination of time extension for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

2. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations.

The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

**MONTHLY ANTICIPATED ADVERSE WEATHER DELAY  
WORK DAYS BASED ON (5) DAY WORK WEEK**

<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
(09)	(10)	(09)	(07)	(06)	(05)	(04)	(04)	(05)	(06)	(06)	(08)

3. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled workday. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph 2 above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)". (ER 415-1-5) (31 Oct 89)

**23 SCHEDULING AND DETERMINATION OF PROGRESS**

Pursuant to the contract clause, SCHEDULES FOR CONSTRUCTION CONTRACTS, the Contractor shall prepare and submit for approval a practicable project schedule. The type of schedule and detailed requirements as well as timing of this submittal shall be as specified in specification section 01310 'PROJECT SCHEDULE'.

This schedule will be the medium through which the timeliness of the Contractor's construction effort is appraised. When changes are authorized that result in contract time extensions, Contractor shall submit a modified schedule for approval by the Contracting Officer.

The terms of Contract Clause, SCHEDULING FOR CONSTRUCTION CONTRACTS, with reference to overtime, extra shifts, etc., may be invoked when the Contractor fails to start or complete work features or portions of same by the time indicated by the milestones dates on the approved project schedule, or when it is apparent to the Contracting Officer from the Contractor's actual progress that these dates will not be met.

Neither on the project schedule as originally submitted nor on any updated periodic schedules which the Contractor is required to prepare and submit, shall be actual progress to be entered include or reflect any materials which even though on the site, are not yet installed or incorporated in the work. For payment purposes only, an allowance will be made by the Contracting Officer of up to 100 percent of the invoiced cost of

materials or equipment delivered to the site but not incorporated into the construction, pursuant to Contract Clause, PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS. The making of such an allowance will be contingent upon a determination by the Contracting Officer that the Contractor's compliance with the quality control requirements of the contract is more than satisfactory.

#### 24 IDENTIFICATION OF EMPLOYEES

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work to display such identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon the release of any employees. When required by the Contracting Officer, the Contractor shall obtain and submit finger-prints of all persons employed or to be employed on the project. (DOD FAR Supplement 52.236-7007)

#### 25 NOT USED.

#### 26 NOT USED

#### 27. NOT USED

#### 28. NOT USED

#### 29 MISPLACED MATERIAL

Should the Contractor, during the progress of the work, lose, dump, throw overboard, Sink, or misplace any material, plant, machinery, or appliance, which in the opinion of the Contracting Officer may be dangerous to or obstruct navigation, the Contractor shall recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such obstructions, to the Contracting Officer or inspector, and when required shall mark or buoy such obstructions until the same are removed. Should he refuse, neglect, or delay compliance with the above requirements, such obstructions may be removed by the Contracting Officer, and the cost of such removal may be deducted from any money due or to become due the Contractor, or may be recovered under his bond. The liability of the Contractor for the removal of a vessel wrecked or sunk without fault or negligence shall be limited to that provided in Sections 15,19, and 20 of the River and Harbor Act of March 3, 1899. (33 U.S.C. 410 et seq.) (DOD FAR Supplement 52.236-7006)

#### 30. SUPERINTENDENCE OF SUBCONTRACTORS (JAN 1965)

a. The Contractor shall be required to furnish the following, in addition to the superintendence required by the Contract Clause titled, 'SUPERINTENDENCE BY THE CONTRACTOR.'

(1) If more than 50% and less than 705 of the value of the contract work is subcontracted, one superintendent shall be provided at the site and on the Contractor's payroll to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

(2) If 70% or more of the value of the work is subcontracted, the Contractor shall be required to furnish two such superintendents to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

b. If the Contracting Officer, at any time after 50% of the subcontracted work has been completed, finds that satisfactory requirement is being made, he may waive all or part of the above requirement for additional superintendence subject to the right of the Contracting Officer to reinstate such requirement if at any time during the progress of the remaining work he finds that satisfactory progress is not being made.  
(DOD FAR Supplement 52.236-7008)

### 31 PROCEDURES FOR SUBMISSIONN AND PAYMENT OF ALL CONTRACT PAYMENTS

In addition to the requirements contained in the Contract Clause entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION COTNRACTS" and to implement the requirements of the Prompt Payment Act Amendments of 1988, P.L. 100-496, the following shall apply to all payments made under this contract:

a. At the time of submission of the progress chart, the Contractor shall submit for approval by the Contracting officer or his authorized representative a breakdown of the contract work which shall be to the degree of detail required by the Contracting Officer, or his representative, to effect reasonable progress payments. The Contracting Officer, or his representative, shall review this breakdown within 30 calendar days after receipt and either advise the Contractor that it is approved or disapproved, and if disapproved the reasons for disapproval. Only after the breakdown is approved shall any payment invoice be accepted from the Contractor and any payment made to him. The Contracting Officer can determine if it is in the best interest of the Government to make payment without an approved breakdown; however, in no case shall more than 10% of the contract amount be paid unless the breakdown is approved.

b. The Contractor shall submit his request for payment by submission of a proper invoice tot he office or person(s) designated in subparagraph c. For purposes of payment a "proper invoice" is defined as the following:

(1) An estimate of the work completed in accordance with the approved breakdown indicating the percentage of work of each item and the associated costs.

(2) A properly completed Eng Form 93 and 93a (where required).

(3) All contractual submissions indicated elsewhere in this contract to be submitted with payment, such as updated progress schedules, updated submittal registers, etc.

(4) The following certification executed by a responsible official of the organization authorized to bind the firm. A “responsible official” would be a corporate office, partner, or owner, in the case of a sole proprietorship.

I hereby certify, to the best of my knowledge and belief, that –

(a) The amounts requested are only for performance in accordance with the specifications, terms and conditions of the contract;

(b) Payments to subcontractors and suppliers have been made from previous payments received under the contract and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract requirements and the requirements of Chapter 39 of Title 31, United States Code; and

(c) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.

(d) All required prime and subcontractor payrolls have been submitted.

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Date)

c. The Government shall designate the office or person(s) who shall first receive the invoice submissions and the Contractor shall be so notified at the pre-construction conference. In addition to the designated Project Engineer, the Contractor shall at the same time submit one copy of the detailed breakdown and the Eng Form 93 and 93a Form to the Area Engineer.

d. The Government representative shall return any request for payment which is deemed defective within 7 days of receipt and shall specify the defects. If the defect concerns a disagreement as to the amount of work performed and or the amount of the

payment being submitted, the Government and the Contractor's representative should meet to resolve the difference and reach agreement. Upon agreement, the Contractor shall submit a new breakdown and Eng Form 93 (and 93a) and any other submissions requiring correction. These will be incorporated with the previous submittal and will then constitute a proper invoice.

e. If agreement cannot be reached, the Government shall determine the proper amount per Contract Clause, PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS and process the payment accordingly. In this event, a "proper invoice" for Prompt Payment Act purposes will not have been submitted to the Government.

f. The Government shall pay the Contractor in accordance with the following time frames:

(1) Progress Payments . From the date a "proper invoice" is received, in accordance with subparagraphs b and d of this clause, the Government will issue a check with 14 calendar days.

(2) Reduction in Retainage Payment. If during the course of the contract, a reduction in retainage payment is required, the Government shall issue a check within 14 calendar days after the approval of the release to the Contractor by the Contracting Officer or his authorized representative.

(3) Final Payment. A final payment request shall not be considered valid until the Contractor has fulfilled all contract requirements including all administrative items, payrolls, warranties, etc. and has submitted a release of claims. When the Contractor has fulfilled all contract requirements and a "proper invoice" has been submitted, the Government shall issue a check within 14 days from the date of acceptance of the project by the Contracting Officer.

## 32 VERIFICATION OF SMALL BUSINESS UTILIZATION

a. This clause is applicable to small business concerns whose contracts exceed \$1,000,000.

b. In accordance with the clause at FAR 52.219-8, entitled UTILIZATION OF SMALL BUSINESS CONCERNS AND DISADVANTAGED BUSINESS CONCERNS, in effect on the date of this contract, the Contracting Office may survey the extent of small and small disadvantaged business utilization under this contract. The Contractor may be required to report to the Contracting Officer statistical data on the number and dollars amounts of subcontracting awards with small business and small disadvantaged businesses.

c. As appropriate, the Contracting Officer may require one or more follow-up reports to the initial report.

d. The Contractor agrees to insert this clause in any subcontract that may exceed \$1,000,000, including this subparagraph d.

33 HAZARDOUS MATERIAL IDENTIFICATION & MATERIAL SAFETY DATA  
(NOV 1991)

a. Hazardous material, as used in this clause, includes any material defined as hazardous under the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract.)

b. The offeror must list any hazardous material, as defined in paragraph a of this clause, to be delivered under this contract. The hazardous material shall be properly identified and include any applicable identification number, such as National Stock Number or Special Item Number. This information shall also be included on the Material Safety Data Sheet submitted under this contract.

Material (if none, insert NONE)

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Identification No.

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c. The apparently successful offeror, by acceptance of the contract, certifies that the list in paragraph b of this clause is complete. This list must be updated during performance of the contract whenever the Contractor determines that any other material to be delivered under this contract is hazardous.

d. The apparently successful offeror agrees to submit, for each item as required prior to award, a Material Safety Data Sheet, meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous material, identified in paragraph b of this clause. Data shall be submitted in accordance with Federal Standard No. 313, whether or not the apparently successful offeror is the actual manufacturer of these items. Failure to submit the Material Safety Data Sheet prior to award may result in the apparently successful offeror being considered nonresponsible and ineligible for award.

e. If, after award, there is a change in the composition of the item(s) or a revision to Federal Standard No. 313, which renders incomplete or inaccurate the data submitted under paragraph d of this clause or the certification submitted under paragraph c of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

f. Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

g. Nothing contained in this clause shall relieve the Contractor from complying with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

h. The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

(1) To use, duplicate and disclose any data to which this clause is applicable. The purposes of this right are to -

(i) Apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting or disposing of hazardous materials.

(ii) Obtain medical treatment for those affected by the material; and

(iii) Have other use, duplicate, and disclose the data for the Government for these purposes

(2) To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph (h)(1) of this clause, in precedence over any other clause of this contract providing for rights in data.

(3) The Government is not precluded from using similar or identical data acquired from other sources. (FAR 52.223-3)

#### 34 SAFETY AND HEALTH REQUIREMENTS MANUAL

If this contract is for construction or dismantling, demolition, or removal of improvements with any Department of Army agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation. The latest edition of the U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, as referenced in the Accident Prevention clause of Section 00700 CONTRACT CLAUSES, is dated 2 SEP 1996.

Before commencing the work, the Contractor shall: (1) Submit a written proposal for implementing the Accident Prevention Plan; and (2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

### 35 SPECIAL SCHEDULING REQUIREMENTS FOR MECHANICAL AND ELECTRICAL SYSTEMS

In reference to the contract clause entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS", see Section 01450 TESTING FOR MECHANICAL AND ELECTRICAL SYSTEMS for additional scheduling requirements for such systems.

### 36 SUBMISSION OF CLAIMS

The following shall be submitted to the Contracting at the following address: U.S. Army Corps of Engineers, New York District, 26 Federal Plaza, New York, New York 10278-0090:

- a. claims referencing or mentioning the Contracting Disputes Act of 1978
- b. requests for a written decision by the Contracting Officer
- c. claims certified in accordance with the Contract Disputes Act of 1978

No other Government representative is authorized to accept such requests. A copy shall also be provided to the Authorized Representative of the Contracting Officer.

The Contractor shall also provide the Contracting Officer with a copy of any requests for additional time, money or interpretation of contract requirements which were provided to the Authorized Representative of the Contracting Officer and which have not been resolved after 90 days.

### 37 PARTNERSHIP IMPLEMENTATION PLAN

To more effectively accomplish this contract, the Government proposes to form a partnership with the Contractor. This partnership would draw on the strengths of each organization in an effort to achieve a quality product within budget and on schedule. This partnership would be bilateral in make-up and participation would be totally voluntary. The Contractor shall hire a facilitator who would be responsible to arrange for an offsite conference location, provide all workshop materials, and compile and distribute a completed partnering agreement to all participants within 30 days of the partnering session. Conference site location will be coordinated with the Contracting Officer for approval. Contractor should plan for the attendance of approximately 15-20 individuals from the Government in addition to the Contractor's and Sub-contractor's personnel. The

costs associated with the partnership conference will be borne by the Contractor. It is anticipated that the partnership conference will be for one day each time and will be held on a monthly basis.

### 38. PRECONSTRUCTION CONFERENCE

a. A preconstruction conference will be arranged by the Contracting Officer, or his Representative, after award of contract and before commencement of work. The Contracting Officer's representative will notify the Contractor of the time and date set for the meeting. At this conference, the Contractor shall be oriented with respect to Government procedures and line of authority, contractual, administrative, and construction matters. Additionally, a schedule of required submittals will be discussed.

b. The Contractor shall bring to this conference the following items in either completed or draft form:

- The Contractor's order of work
- Accident Prevention Plan
- Quality Control Plan
- Letter appointing Superintendent
- List of subcontractors.

### 39. GOVERNMENT RESIDENT MANAGEMENT SYSTEM AND CONTRACTOR QUALITY CONTROL MODULE

The Government will utilize an in-house Contract Administration program entitled "Resident Management System" (RMS). The Contractor shall utilize a Government furnished CQC Programming Module. The following hardware and software are needed by the contractor to run RMS: A personal computer with 8-0386 processor (or higher) and four megabytes (MB) or more of random access memory (RAM) and a 3-1/2 inch high density floppy drive. Also needed is a HP Laser Jet Series II or III printer, a color monitor, MS-DOS version 5.0 or later, and computer files = 81. The Module includes a Daily CQC Reporting System form, which must also be used. This form may be in addition to other contractor desired reporting forms. However, all other such reporting forms shall be consolidated into this one Government specified Daily CQC Report Form. The contractor will also be required to complete CQC Module elements which include, but are not limited to, all Contractor Quality Control plan information such as; Prime Contractor staffing, subcontractor information showing trade, name, address, and point of contact, definable features of work, pay activities and activity information, required Quality Control tests tied to individual pay activities, planned User schooling tied to specific specification paragraphs and pay activities, Installed Property listings, Transfer Property listings, and submittal information relating to specification section, description, pay activity, and expected procurement period. The sum of all pay activities shall equal the contract amount, and all Bid Items, Options and Additives shall be separately identified, in accordance with the Bidding Schedule. Bid Items may include multiple

activities, but activities may only be assigned to one such Bid Item. This module shall be completed to the satisfaction of the Contracting Officer prior to any contract payment (except for Bonds, and Insurance, as approved by the Contracting Officer) and shall be updated as required.

During the course of the contract, the contractor will receive various Quality Assurance comments from the Government that will reflect corrections needed to contractor activities or reflect outstanding or future items needing attention of the contractor. The contractor will acknowledge receipt of these comments by specific number reference on his daily CQC report, and will also reflect on his daily CQC report when these items are specifically completed or corrected to permit Government verification.

#### 40 CONSTRUCTION COLOR BOARD SUBMITTALS

The Contractor shall submit five sets of color boards depicting samples of all finish materials. The color board (finishes sample submittal package) shall include all visible exterior and interior materials and finishes that are a part of the building (and/or structure) or built-in items provided under this contract. The color boards shall be delivered to each of the addresses listed below.

4 Color Boards to: Paul Kara  
Resident Office  
New York District  
Building 5212  
Maryland Avenue  
Fort Dix, NJ 08640

1 Color Board to: Mason and Hangar  
2355 Harrodsbury Road  
Lexington, KY 40504

The Contractor shall furnish his color board submitted to each of the addresses within 90 days after receipt of the notice to proceed, but more than 30 days prior to ordering finishing materials. The Contractor should obtain approvals of his entire color board submission before beginning any work involving final finishes.

The Contractor shall use the following format when assembling the color boards:

a. Provide the samples on 8 ½ x11-inch board modules with a maximum spread of 25 ½ x33-inches for foldouts. Label the modules with the project titles and design them to fit in a standard loose-leaf, three-post binder. The modules should support and anchor all samples. Anchor large or heavy samples with mechanical fasteners.

b. Organize the submittals in a logical manner to allow a fast review. Write descriptions and explanations clearly. Drawings and photographs must be clear and concise.

c. Organize samples by scheme with a separate scheme for each room or for groups of rooms with the same scheme. Coordinate the schemes by room names and numbers shown on the architectural floor plans and room finish and color schedule. Include floor plans and schedules in modules.

d. Indicate true pattern color and texture for interior material and finish samples. Carpet samples should be large enough to indicate a complete pattern or design, but not less than 3 by 5 inches.

e. Include color/finish pattern and texture for exterior materials and finishes

f. Provide at least a 6x6-inch square sample where either interior or exterior special finishes, such as architectural concrete or pre-finished textured metal panels, are required.

#### 41. YEAR 2000 COMPLIANCE

##### a. Commercial Computer Systems and Programming

The Contractor shall warrant fault free performance in the processing of date and related data (including but not limited to calculating, comparing, and sequencing) by all hardware and software products, individually and in combination from date of contract award. Fault free performance shall include the manipulation of this data when dates are in the 20<sup>th</sup> and 21<sup>st</sup> centuries and shall be transparent to the User.

##### b. Microprocessors as Part of Systems

All microprocessor-based equipment, software, or firmware which will be required to process date/time calculations, installed in any system in this contract shall be year 2000 compliant. Typical systems include, but are not limited to, Fire Alarm Systems, Intrusion Detection Systems, HVAC Control Systems, Utility or Energy Monitoring and Control Systems, Traffic Control systems, Elevator Controls, telephone systems, electrical substation controls, utility monitoring and controls at energy plants or fuel storage facilities, local area networks, communications systems, public address systems, and specialty systems such as for research laboratories, etc. These systems shall be year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the 20<sup>th</sup> and 21<sup>st</sup> centuries, including leap year calculations. In addition, these systems, when used in combination with other information technology (either installed as part of this contract or

by others) shall accurately process date/time data, provided the other information technology properly exchanges date/time data with it.

**42, WEIGHTED GUIDELINES METHOD FOR THE CALCULATION OF PROFIT FOR CONTRACT MODIFICATIONS.**

Factor	Rate	Weight	Value
Degree of risk	20		
Relative difficulty of work	15		
Size of job	15		
Period of performance	15		
Contractor's investment	5		
Assistance by government	5		
Subcontracting	<u>25</u>		
	100		_____%

42.1 For every modification executed under this contract, profit shall be calculated by considering at every tier, each of the above factors. These factors shall be weighted from .03 to .12 as indicated below. The value column, when totaled, indicates the fair and reasonable profit percentage for the modification. This method shall be used, at every contracting tier, to establish the profit factor, for that tier, for every modification under this contract.

**42.1.1 Degree of Risk.**

Where the work involves no risk or the degree is very small, the weighting should be .03; as the degree of risk increases the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than unit price items for which quantities are provided. Other things to consider: The portion of the work to be done by subcontractors, nature of the work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, whether the negotiation is before or after performance of work, etc.

**42.1.2 Relative Difficulty of Work.**

If the work is most difficult and complex the weighting should be .12 and should be proportionately reduced to .03 to the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: The nature of the work, by whom it is to be done, where, what is the time schedule, etc.

**42.1.3 Size of Job.**

All work not in excess of \$100,000 shall be weighted at .12. Work estimated between \$100,000 and \$5,000,000 shall be proportionately weighted from .12 to .05. Work from \$5,000,000 to \$10,000,000 shall be weighted at .04 and work in excess of \$10,000,000 at .03.

**42.1.4 Periods of Performance.**

Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. the term “jobs” refers to the duration of work required under the modification.

#### 42.1.5 Contractor’s Investment.

To be weighted from .03 to .12 on the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, government-furnished property, method of making progress payments, etc.

#### 42.1.6 Assistance by Government.

To be weighted from .12 to .03 on the basis of average to above average. things to consider: use of government owned property, equipment and facilities, expediting assistance, etc.

#### 42.1.7 Subcontracting.

To be weighted inversely proportional to the amount of subcontracting. Where 80% or more of the work is to be subcontracted the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the contractor’s own forces.

42.2. When considered necessary because of unusual circumstances or local conditions, the range of weight may be increased to an upper limit of .15 if supported by adequate justification and approval of the ACO.

#### 43. PRICING of CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY:

The contractor shall promptly furnish and shall cause any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures, and equipment furnished and/or installed by the contractor or subcontractor, except prices do not need to be provided for Government-furnished Property. This information shall be listed in the RMS CQC Module furnished by the Government.

**SUBMITTAL REGISTER**

(ER 415-1-10)

CONTRACT NO.:

TITLE AND LOCATION

CONTRACTOR:

SPECIFICATION SECTION:  
**00700 & 00800**

ACTIVITY NO.	TRANSMITTAL NO.	ITEM NO.	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL													CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
					DRAWINGS	STANDARD SPECIFICATIONS	STATEMENTS	CERTIFICATES	RECORDS	PERMITS	SPECIAL	REVISIONS	O&M	INFORMATION	GOVERNMENT	APPROVAL	SUBMIT TO GOVERNMENT	CODE	DATE	SUBMIT TO GOVERNMENT	CODE	DATE				
																							DATE	DATE	DATE	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	aa
			00800-10	As-Built Drawings	X																					
			00800-12.1.3	Small Tool Usage Plan				X																		
			00800-15.2	SF1413	X																					
			00800-19.3(1)	Prel. Network Analysis			X																			
			00800-19.3(2)	Complete Network Anal			X																			
			00800-19.5	Updated Network Anal			X																			
			00800-20.1.7	Warranties				X	X																	
			00800-38.2	Notice of Soils Treatmt.	X																					
			00800-40	Lbr., Equip. & Matl.																						
				Rpts for Ext. Work				X																		
			00800-42	Progress Photographs	X																					
			00800-45	Insurance Certification					X																	
			00700-88	Accident Prevention Plan				X																		
			00700-89	Construction Schedule			X																			



























































































































































# STATEMENT AND ACKNOWLEDGMENT

FORM APPROVED OMB NO  
9000-0014

Public reporting burden for this collection of information is estimated to average .15 hours per response, including the time for reviewing instructions. Searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the suggestions for reducing this burden, to the FAR Secretarial (VRS), Office of Federal Acquisition and Regulatory Policy, GSA Washington, D.C. 20405: and to the Office of Management and Budget, Paperwork Reduction Project (9000-0014), Washington, D.C. 20503

## PART I - STATEMENT OF PRIME CONTRACTOR

1. PRIME CONTRACT NO.	2. DATE SUBCONTRACT AWARDED	3. SUBCONTRACT NUMBER
4. PRIME CONTRACTOR (Name, address and ZIP code)		5. SUBCONTRACTOR (Name, address and ZIP code)
6. The prime contractor states that under the contract shown in item 1, a subcontract was awarded on date shown in item 2 by (Name of Awarding Firm)		

to the subcontractor identified in item 5, for the following work:

7. PROJECT	8. LOCATION	
9. NAME AND TITLE OF PERSON SIGNING	10. BY (Signature)	11. DATE SIGNED

## PART II - ACKNOWLEDGMENT OF SUBCONTRACTOR

12. The subcontractor acknowledges that the following clauses of the contract shown in item 1 are included in this subcontract:

Contract Work Hours and Safety	David-Bacon Act
Standards Act - Overtime	Apprentices and Trainees
Compensation - Construction	Compliance with Copeland Regulations
Payrolls and Basic Records	Subcontracts
Withholding of Funds	Contract Termination-Debarment
Disputes Concerning Labor Standards	Certification of Eligibility

13. NAME(S) OF ANY INTERMEDIATE SUBCONTRACTORS, IF ANY

14. NAME AND TITLE OF PERSON SIGNING	15. BY (Signature)	16. DATE SIGNED
--------------------------------------	--------------------	-----------------

(Sample of Typical contractor Quality report)

CONTRACTOR'S NAME  
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract No: \_\_\_\_\_ Date: \_\_\_\_\_ Report No. \_\_\_\_\_

Project Name \_\_\_\_\_

Weather: (Clear) (P. Cloudy) (Cloudy); Temperature: \_\_\_\_Min. \_\_\_\_Max; \_\_\_\_ Rainfall \_\_\_\_ in.

<u>Contractor/Subcontractors/Supplier</u>	<u>Area of Responsibility</u>
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____
e. _____	_____
f. _____	_____
g. _____	_____

1. Definable Features of Construction in Progress: (Give briefly only definable features of work in progress and location. Refer to work performed by prime and/or subcontractor and/or supplier by letter in table above).

2. Material and/or Equipment Delivered to site: \_\_\_\_\_

3. Results of Surveillance: \_\_\_\_\_

Preparatory Phase (Attach minutes):

Initial Phase (Attach minutes):

Follow-up Phase (Include satisfactory work completed and/or deficiencies with action to be taken):

24 October 1988

4. Tests Required by Plans and/or Specification Performed and results of Test:  
(Attach results of test taken on previous dates).

---

5. Verbal Instructions Received: (List any instructions given by Government Personnel on construction deficiencies. Retesting required, etc., with action to be taken).

---

6. Safety Deficiencies Noted. (Describe corrective actions taken).

---

7. Remarks: (Cover any conflicts in plans, specifications, or instruction).

---

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

---

Contractor's Authorized QC Representative

All Construction Project Identification signs and Safety Performance signs are to be fabricated and installed as described below. The signs are to be erected at a location designated by the contracting officer and shall conform to the size, format, and typographic standards shown

The sign panels are to be fabricated from .75" High Density Overlay Plywood.

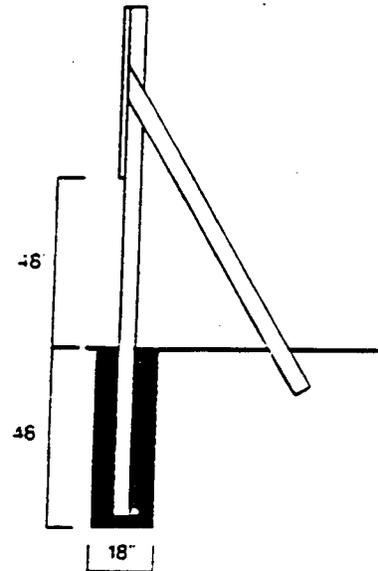
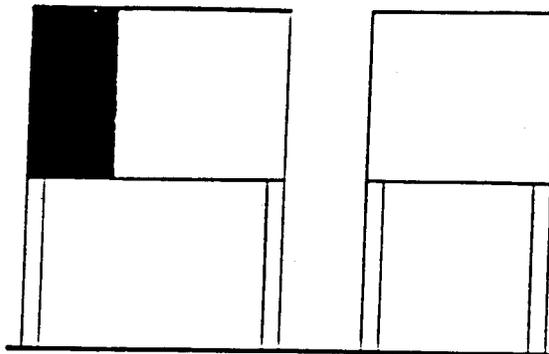
All graphics are to be applied to the background panel following the graphic formats as indicated.

Drill and insert six (6) .375" T-nuts from the front face of the HDO sign panel. Flange of T-nut to be flush with sign face.

Apply lettering and logo to prepared HDO plywood panel.

Sign uprights to be structural grade 4"x4" treated Douglas Fir or Southern Yellow Pine, No. 1 or better. Post to be 12' long. Drill six (6) .375" mounting holes in uprights to align with T-nuts in sign panel. Countersink (.5") back of hole to accept socket head cap screw (4"x.375").

Assemble sign panel and uprights. Imbed assembled sign panel and uprights in 4' hole. Bolt additional 2"x4" struts on inside face of uprights to reinforce installation as shown.



**Construction Project Sign**  
**Legend Group 1: Corps Relationship**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

**Legend Group 2: Corps Signature**

- 1. U.S. Army Corps
- 2. of Engineers

**Legend Group 2A: District Name**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

**Legend Group 3: Project Title**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_

**Legend Group 4: Facility Name**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

**Legend Group 5a: Designer**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

**Legend Group 5b: Contractor**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

## Introduction: Project Identification Sign

Below are two samples of the construction project identification sign showing how this panel is adaptable for use to identify either civil works projects with a local sponsor (top) or military (bottom). The graphic format for this 4' x 6' sign panel follows the legend guidelines and layout as specified

below. The large 4' x 4' section of the panel on the right is to be white with black legend. For the top sign, the upper left 2' x 2' section of the sign with the full Corps signature is to be painted Communications Red with white lettering. The lower left 2' x 2' section of the sign shall match the local sponsor's colors

with white lettering. For the bottom sign, the 2' x 4' left section of the sign with full Corps signature is to be painted Communications Red with white lettering. Mounting and fabrication details are provided.

**Legend Group 1:** One-to two-line description of Corps relationship to project.  
Color: White  
Typeface: 1.25" Helvetica Regular  
Maximum line length: 19"

**Legend Group 2:** Two-line Corps Signature (US Army Corps of Engineers). Placed below Corps Castle  
Color: White  
Typeface: 1.5" Helvetica Bold

**Legend Group 2a:** District Name. Placed below Signature (6" Castle).  
Color: White  
Typeface: 1.25" Helvetica Regular

**Legend Group 3:** Words "Local Sponsor"  
Color: White  
Typeface: 1.25" Helvetica Regular  
Maximum length: 19"

**Legend Group 4:** One-to-three lines for name of local sponsor  
Color: White  
Typeface: 1.5" Helvetica Regular

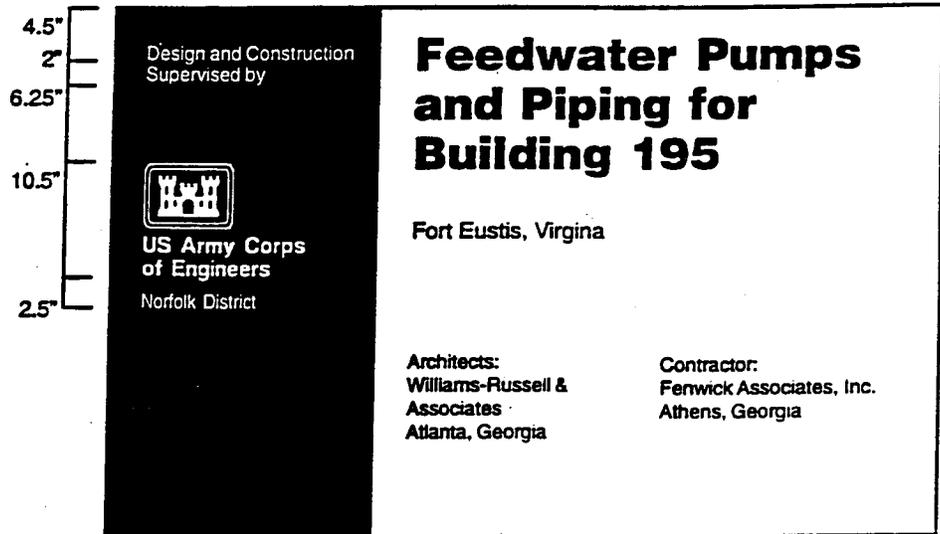
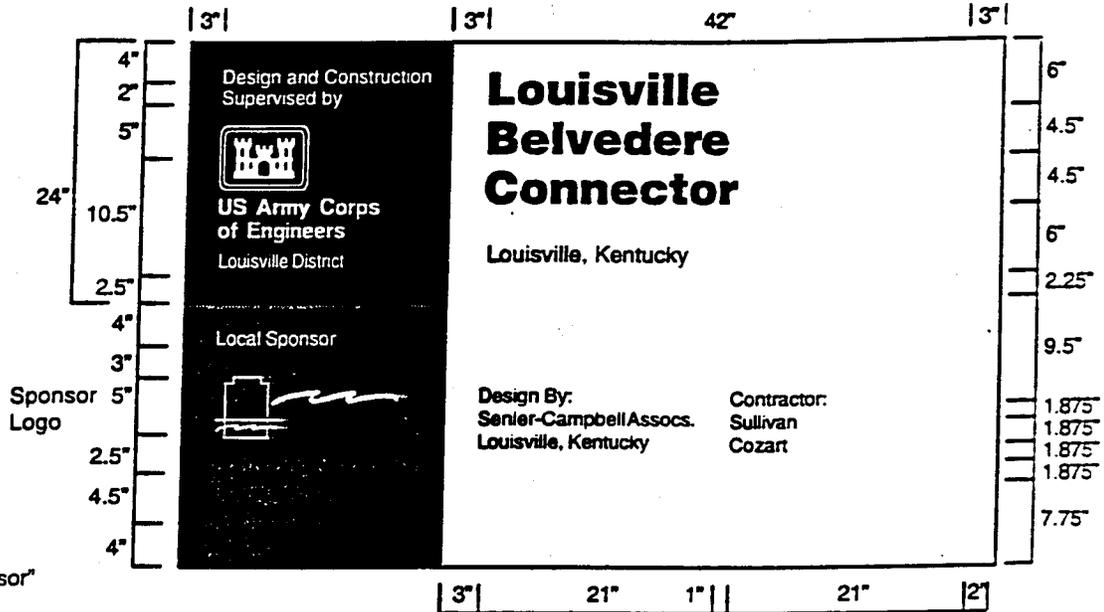
**Legend Group 5:** One- to three-line project title legend describes the work being done under this contract.  
Color: Black  
Typeface: 3" Helvetica Bold  
Maximum line length: 42"

**Legend Group 6:** One- to two-line identification of project or facility (civil works) or name of sponsoring department (military).  
Color: Black  
Typeface: 1.5" Helvetica Regular  
Maximum line length: 42"

Cross-align the first line of Legend Group 5 with the first line of the Corps Signature (US Army Corps) as shown.

**Legend Groups 7a-b:** One- to five-line identification of prime contractors including: type (general contractor, etc.) corporate or firm name, city, state.  
Color: Black  
Typeface: 1.25" Helvetica Regular  
Maximum line length: 21"

All typography is flush left and rag right, upper and lower case with initial capitals only as shown.



Legend Size	Panel Size	Post Size	Mounting Height	Color Bkg/Lgd
Various	4' x 6'	4" x 4"	48"	WH-RD/BK



## Instructions

1. Section I will be initiated by the contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; in resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.
5. Separate transmittal form will be used for submittals under separate section of the specifications.
6. a check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications—also, a written statement to that effect shall be included in the space provided for "Remarks.
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g. to each item submitted.

### THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

- A – Approved as submitted.
  - B – Approved, except as noted on drawings.
  - C – Approved, except as noted on drawings. Refer to attached sheet resubmission required.
  - D – Will be returned by separate correspondence.
  - E – Disapproved (See attached).
  - F – Receipt acknowledged.
  - FX – Receipt acknowledged, does not comply as noted with contract requirements.
  - G – Other (*Specify*)
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

*(Reverse of ENG form 4025-R)*



General Decision Number NJ990002

Superseded General Decision No. NJ980002

State: New Jersey Construction Type:

BUILDING

HEAVY

HIGHWAY

County(ies):

ATLANTIC	CUMBERLAND	OCEAN
BURLINGTON	GLOUCESTER	SALEM
CAMDEN	MERCER	
CAPE MAY	MONMOUTH	

Building (excluding single family homes and apartments up to and including 4 stories), Heavy and Highway Construction Projects.

Modification Number	Publication Date
---------------------	------------------

0	01/22/1999
1	03/19/1999
2	04/02/1999
3	05/07/1999
4	05/14/1999
5	05/21/1999
6	06/04/1999
7	07/02/1999
8	07/09/1999

COUNTY(ies):

ATLANTIC	CUMBERLAND	OCEAN
BURLINGTON	GLOUCESTER	SALEM
CAMDEN	MERCER	
CAPE MAY	MONMOUTH	

ASBE0014C 05/01/1998

	Rates	Fringes
--	-------	---------

BURLINGTON (townships of Edgewater Park, Lumberton, Sampton, Shamong, Tabernacle, Westhampton, & Willingboro), CAMDEN, & GLOUCESTER COUNTIES:

ASBESTOS WORKERS/INSULATORS

(includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems. Also the application of firestopping material, openings and penetrations in walls, floors, ceilings, curtain walls and all lead abatement).

25.835	12.925
--------	--------

-----  
 ASBE0085A 06/01/1994

	Rates	Fringes
--	-------	---------

ASBESTOS WORKERS/INSULATORS

Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems

ZONE 1	20.20	6.35
ZONE 2	18.30	6.825

ZONE 3 19.64 4.04

ASBESTOS WORKERS ZONE DEFINITIONS

ZONE 1: ATLANTIC, BURLINGTON (Bass River and Washington Twps.); CAPE MAY, CUMBERLAND AND OCEAN (Eaglewood, Lacy, Little Egg Harbor, Long Beach, Ocean, Stafford, Tuckerton, and Union Twps.) COUNTIES.

ZONE 2: MONMOUTH (Remainder of County)

ZONE 3: SALEM COUNTY

-----  
ASBE0089G 07/01/1998

Rates Fringes  
BURLINGTON (includes the townships of Bordentown, Burlington, Chesterfield, Easthampton, Florence, Mansfield, Mount Holly, New Hanover, North Hanover, Pembereton, Roebling, Springfield, Wrightstown, & Woodland); MERCER COUNTY; MONMOUTH (includes the townships of Allentown, Blansingburg, Brielle, Englishtown, Farmingdale, Freehold, Howell, Manasquan, Millstone, Roosevelt, Sea Crit, South Belmar, Spring Lake Heights, Upper Freehold, Wall, & West Belmar); & OCEAN (includes the townships of Beachwood, Berkeley, Breton Woods, Brick, Cederwood Park, Dover, Gillford Park, Island Beach, Island Heights, Jackson, Lakehurst, Lakewood, Manchester, New Egypt, Ocean Gate, Pine Beach, Plumstead, South Toms River & Toms River) COUNTIES:

ASBESTOS WORKERS/INSULATORS

Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems

25.545 14.195

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BOIL0028C 08/01/1998

Rates Fringes  
BOILERMAKERS 30.23 40%+4.08

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BRNJ0006A 11/01/1996

Rates Fringes  
BURLINGTON AND MERCER COUNTIES:  
BRICKLAYERS, STONEMASONS, MARBLE MASONS, CEMENT MASONS, (Excludes Building Construction for Mercer County), PLASTERERS, TILE LAYERS, & TERRAZZO WORKERS 24.34 12.10

-----  
BRNJ0007A 11/01/1996

Rates Fringes  
CAMDEN, GLOUCESTER AND SALEM COUNTIES  
BRICKLAYERS, MARBLE MASONS, STONE MASONS AND TERRAZZO WORKERS 25.26 11.15

-----  
BRNJ0008A 11/01/1996

Rates Fringes  
MONMOUTH AND OCEAN COUNTIES  
BRICKLAYERS, CEMENT MASONS, MARBLE MARBLE MASONS, PLASTERERS STONE MASONS, TERRAZZO WORKERS, AND TILE LAYERS 24.88 11.56

-----  
BRNJ0033A 11/01/1996

	Rates	Fringes
ATLANTIC, CAPE MAY AND CUMBERLAND COUNTIES BRICKLAYERS, CEMENT MASONS, MARBLE MASONS, PLASTERERS, STONEMASONS, TERRAZZO WORKERS & TILE LAYERS	23.75	12.76
-----		
CARP0031B 05/01/1997		
	Rates	Fringes
MERCER COUNTY (Remainder)		
CARPENTERS & INSULATORS	26.28	12.34
MILLWRIGHTS	26.28	12.34
-----		
CARP0454B 07/01/1998		
	Rates	Fringes
DOCK BUILDERS & PILEDRIVERMEN	24.08	15.36+A
FOOTNOTE:		
A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Presidential Election Day, and Thanksgiving Day; provided employee works any of the 3 days in the 5-day work week preceeding the holiday and the first work day after the holiday.		
-----		
CARP0623A 05/01/1998		
	Rates	Fringes
ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER AND SALEM COUNTIES		
CARPENTERS, INSULATORS, MILLWRIGHTS AND SOFT FLOOR LAYERS	27.14	42%+.15
-----		
CARP0781A 05/01/1997		
	Rates	Fringes
MERCER COUNTY (Beginning from the present Post Office in Lawrenceville to a point Northward through the present "Radio Site" to the junction of Rosedale Road and Read's Mill Road to the junction of Pennington and Mount Rose Road to the Somerset County line, again starting at the present Post Office in Lawrenceville and Eastward to the junction of Brunswick Pike and Delaware and Raritan Canal Bridge taking the center of the Road to CLarksville then South on Providence Line Road to the Pennsylvania Railroad then East on Dutch Neck North to Grover's Mills to the Middlesex County Line)		
CARPENTERS	27.20	.155+38%
MILLWRIGHTS	27.70	.155+38%
-----		
CARP0999B 12/03/1994		
	Rates	Fringes
CAMDEN, GLOUCESTER AND SALEM COUNTIES		
TERRAZZO FINISHERS	12.93	5.05
-----		
CARP0999C 12/03/1994		
	Rates	Fringes
ATLANTIC AND MONMOUTH COUNTIES:		
TILE FINISHERS	8.45	13%
-----		
CARP0999D 12/03/1994		
	Rates	Fringes

CAMDEN, GLOUCESTER AND SALEM COUNTIES		
TILE FINISHERS	12.72	5.05
-----		
CARP0999E 12/03/1994		
	Rates	Fringes
CAMDEN, GLOUCESTER AND SALEM COUNTIES		
MARBLE FINISHERS	12.95	5.05
-----		
CARP1456G 07/01/1995		
	Rates	Fringes
DIVERS	34.05	17.20
DIVER TENDERS	25.56	17.20
-----		
CARP1456H 07/01/1995		
	Rates	Fringes
MERCER AND MONMOUTH COUNTIES		
DOCK BUILDERS & PILEDRIVERMEN	27.98	17.20
-----		
CARP2018A 05/01/1999		
	Rates	Fringes
OCEAN COUNTY		
CARPENTERS	27.85	42%
MILLWRIGHTS	28.35	42%
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CARP2212B 05/01/1999		
	Rates	Fringes
BURLINGTON, MERCER, MONMOUTH AND OCEAN COUNTIES		
SOFT FLOOR LAYERS	25.75	39.73%
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CARP2250A 05/01/1998		
	Rates	Fringes
MONMOUTH COUNTY		
CARPENTERS	27.14	42%+.15
MILLWRIGHTS	27.64	42%+.15
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ELEC0269D 10/01/1998		
	Rates	Fringes
BURLINGTON (Area North of a line following the West and South limits of Burlington Borough from the Delaware River in a Southeasterly direction to the Burlington - Mt Holly Road, South-Southeast along this Road to and including the Town of Mount Holly, East along the Pennsylvania Railroad to and including New Lisbon and continuing along the Pennsylvania Railroad to Ocean County Line), AND MERCER COUNTIES		
LINE CONSTRUCTION (EXCEPT RAILROAD WORK):		
Linemen, Cable Splicers, Truck Drivers, Equipment Operators and Technicians		
	30.34	5.75+29%
Groundmen and Winch Operators		
	24.27	5.75+29%
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ELEC0269E 04/01/1999		
	Rates	Fringes
BURLINGTON COUNTY (Area North of a line following the West and South limits of Burlington Borough from the Delaware River in a Southeasterly direction to the Burlington - Mount Holly Road, South-Southeast along this road to and including the Town of Mount Holly, East along the Pennsylvania Railroad to and		

including New Lisbon and continuiong along the Pennsylvania Railroad to the Ocean County Line) AND MERCER COUNTIES

ELECTRICIANS & CABLE SPLICERS	31.13	5.20+28%
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 ELEC0351A 04/05/1999

	Rates	Fringes
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ATLANTIC; BURLINGTON (Edgewater park, Delanco, Delran, Cinnaminson,Moorestown, Mount Laurel, Wilingsboro, Hainesport, Lumberton,Medford, Evesham Townships; and the portion of Shamong, Tabernacle, and Woodland Townships North of the Central Railroad of New Jersey Line; and the portion of Burlington, Westhampton, Easthampton, South Hampton and Pemberton Townships South of a line starting at the Delaware River and following the Southern boundary of Burlington Borough to the Burlington - Mount Holly Road, along this road to Mount Holly around but excluding Mount Holly to the Pennsylvania Railroad along the Pennsylvania Line through, but excluding, Pemberton, through but excluding New Lisbon to the Ocean County line and that portion south of the Central Railroad of New Jersey line running through Chatsworth); CAMDEN; CAPE MAY; CUMBERLAND; GLOUCESTER; and SALEM COUNTIES:

ELECTRICIANS & CABLE SPLICERS	28.96	45.05%+,45
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 ELEC0351C 04/05/1999

	Rates	Fringes
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ATLANTIC; BURLINGTON (Edgewater park, Delanco, Delran, Cinnaminson,Moorestown, Mount Laurel, Wilingsboro, Hainesport, Lumberton,Medford, Evesham Townships; and the portion of Shamong, Tabernacle, and Woodland Townships North of the Central Railroad of New Jersey Line; and the portion of Burlington, Westhampton, Easthampton, South Hampton and Pemberton Townships South of a line starting at the Delaware River and following the Southern boundary of Burlington Borough to the Burlington - Mount Holly Road, along this road to Mount Holly around but excluding Mount Holly to the Pennsylvania Railroad along the Pennsylvania Line through, but excluding, Pemberton, through but excluding New Lisbon to the Ocean County line and that portion south of the Central Railroad of New Jersey line running through Chatsworth); CAMDEN; CAPE MAY; CUMBERLAND; GLOUCESTER; and SALEM COUNTIES:

LINEMAN,HEAVY EQUIPMENT OPERATOR,& CABLE SPLICERS	28.96	46.05%+.25
GROUNDMAN	24.62	46.05%+.25

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 ELEC0400A 06/01/1997

	Rates	Fringes
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MONMOUTH AND OCEAN COUNTIES  
 ELECTRICIANS & CABLE SPLICERS 28.96 5.90 + 18%

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 ELEC0400B 06/02/1997

	Rates	Fringes
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MONMOUTH AND OCEAN COUNTIES  
 LINE CONSTRUCTION (Excluding Railroad construction):  
 Lineman, Equipment Operator,  
 and Cable Splicer 28.96 18.75%+5.83  
 Groundman 27.01 18.75%+5.83

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 ELEC0999A 12/03/1994

	Rates	Fringes
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BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, MONMOUTH,  
OCEAN AND SALEM COUNTIES:

LINE CONSTRUCTION (RAILROAD ONLY):

Linemen	16.96	25%
Line Equipment Operator	16.20	25%
Groundman Winch Operator	13.07	25%
Groundman	11.06	25%
Dynamite Man	14.20	25%
Street Light Mechanic	12.97	25%
Line Equipment Mechanic	12.90	25%

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ELEV0999A 12/03/1994

	Rates	Fringes
ELEVATOR MECHANICS	24.01	5.22+A

FOOTNOTE:

- A. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day  
PAID VACATION: Employer contributes 4% of basic hourly rate as vacation pay credit for 5 years or more of service, and 2% for 6 months to 5 years of service.

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ENGI0825B 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS: BUILDING CONSTRUCTION PROJECTS; HEAVY; HIGHWAY; ROAD; STREET AND SEWER PROJECTS:		
GROUP 1	30.62	14.90+A+B
GROUP 2	29.03	14.90+A+B
GROUP 3	27.12	14.90+A+B
GROUP 4	25.49	14.90+A+B
GROUP 5	23.78	14.90+A+B
GROUP 6	32.34	14.90+A+B

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Autograde - Combination Subgrader; base metal spreader and 7 base trimmer (CMI and similar types); autograde placer, trimmer, spreader combination (CMI and similar types); autograde slipform paver (CMI and similar types); backhoe; central power plants (all types); concrete paving machines; cranes (all types, including overhead and straddle traveling type); cranes; gantry; derricks (land or floating); drillmaster, quarrymaster (down the hole drill) rotary drill; self propelled hydraulic drill; self-powered drill; dragline; elevator graders; front end loaders (5 yds. and over); gradalls; grader; raygo; locomotive (large); mucking machines; pavement and concrete breaker, i.e.; superhammer and hoe ram; pile driver; length of boom including length of leads, shall determine premium rate applicable; roadway surface grinder; scooper (loader and shovel); shovels; tree chopper with boom; trench machines.

GROUP 2: "A" frame; backhoe (combination); boom attachment on loaders (rate based on size of bucket) not applicable to pipehook, boring and drilling machines; brush chopper; shredder and tree shredder; tree shearer; cableways; carryalls; concrete pump; concrete pumping system; pumpcrete and similar types; conveyors, 125 ft. and over; drill doctor including dust collector, maintenance); front end loaders (2 yds. but less than 5 yds.); graders (finisher); groove cutting machine (ride on type); header planer; hoists; (all types hoists, shall also

include steam, gas, diesel, electric, air hydraulic, single and double drum, concrete brick shaft caisson, snorkel roof, and/or any other similar type hoisting machines, portable or stationary, except Chicago boom type); hoists (Chicago boom type); hydraulic cranes, 10 tons and under, hydro-axle; jacks screw air hydraulic power operated unit or console type (not hand jack or pile load test type); log skidder; pans; pavers (all concrete; pumpcrete machines; squeezecrete and concrete pumping (regardless of size); scrapers; side booms; straddle carrier; ross and similar types; winch truck (hoisting).

GROUP 3: Asphalt curbing machine; asphalt plant engineer; asphalt spreader; autograder tube finisher and texturing machine (CMI and similar types); autograde curercrete machine (CMI and similar types); autograde curb trimmer and sidewalk; shoulder; slipform (CMI and similar types); bar bending machines (power); batchers; batching plant and crusher on side; belt conveyor systems; boom type skimmer machines, bridge deck finisher; bulldozers (all); car dumpers (railroad); compressor and blower type units (used independently or mounted on dual purposes trucks, on job site or in conjunction with job site in loading and unloading of concrete, cement, fly ash, instancrete, or similar type materials); compressor (2 or 3) (battery); concrete finishing machines; concrete saws and cutters (ride on type); concrete spreaders; hetzel; rexomatic and similar types; concrete vibrators, conveyors; under 125 ft.; crushing machines; ditching machine; small (ditchwitch or similar type); dope pots (mechanical with or without pump); dumpsters elevator; fireman; fork lifts (economobile; lull and similar types of equipment); front end loaders (1 yd. and over but less than 2 yds.). generators (2 OR 3) in battery; giraffe grinders; graders and motor patrols; gunnite machines (excluding nozzle); hammer vibratory (in conjunction with generator); hoist (roof, tigger, aerial platform hoist and house cars); hoppers; hopper doors (power operated); ladders (motorized); laddervator; locomotive; dinky type; maintenance; utility man; mechanics; mixers (except paving mixers); motor patrols and graders; pavement breakers, small; self-propelled ride on type (also maintaining compressor or hydraulic unit); pavement breaker; truck mounted; pipe bending machine (power); roller; black top; scales; power; seaman pulverizing mixer; shoulder widener; silos; skimmer machines (boom type); steel cutting machine; services and maintaining tractors; tug captain; vibrating plants (used in conjunction with unloading); welder and repair mechanics, concrete cleaning/decontamination machine operator, directional boring machine, heavy equipment robotics operator/technician, master environmental maintenance technician, ultra high pressure waterjet cutting tool system operator/maintenance technician, vacuum blasting machine operator/maintenance technician.

GROUP 4: Brooms and sweepers, chippers, compressor (single), concrete spreaders (small type), conveyor loaders (not including elevator graders), engines, large diesel (1620 H.P.) and staging pump, farm tractors; fertilizing equipment (operation and maintenance) fine grade machine (small type); form line graders (small type); front loader (under 1 yd.); generator (single); grease, gas, fuel and oil supply trucks; heaters (nelson or other type including propane, natural gas or flow-type units); lights; portable generating light plants; mixers; concrete small;

mulching equipment (operation and maintenance) pumps (4 inch suction and over including submersible pumps); pumps (2 or less than 4" suction and over including submersible pumps); pumps (diesel engine and hydraulic) immaterial of power road finishing machines (small type); rollers; grade; fill or stone base; seeding equipment (operation and maintenance of); sprinkler and water pump trucks steam jennies and boilers, stone spreader; tamping machines; vibrating ride-on; temporary heating plant (nelson or other type, including propane, natural gas or flow type untis); water and sprinkler trucks; welding machines (gas, diesel, and/or electric converters of Any type, single; two or three in a battery); welding systems, multiple (rectifier transformer type); wellpoint systems.

GROUP 5: Oiler.

GORUP 6: Helicopter Pilot.

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day; Washington'd Birthday, Memorial Day; Independence Day; Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day
- B. Employee receives 20% Premium Pay for Hazardous Waste Work.

ENGI0825C 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS		
TANK ERECTION:		
GROUP 1	33.11	14.90+A+B
GROUP 2	32.27	14.90+A+B
GROUP 3	34.25	14.90+A+B
GROUP 4	30.18	14.90+A+B
GROUP 5	24.97	14.90+A+B

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day; Washington's Birthday Memorial Day; Independence Day; Labor Day; Veteran's Day, Thanksgiving Day; and Christmas Day.
- B. Employee receives 20% premium pay for hazardous waste work.

TANK ERECTION CLASSIFICATIONS

GROUP 1: Operating Engineers--on all Cranes, derricks, etc. with booms including jib 140 ft. or more above the ground.  
 GROUP 2: Operating Engineers--on all equipment, including cranes derricks, etc. with booms including jib, less than 140 ft. above the ground.  
 GROUP 3: Helicopters--Pilot.  
 GROUP 4: Air compressors, welding machines and generators (gas, diesel, or electrical driven equipment and sources of power from a permanent plant, i.e., steam, compressed air, hydraulic or other power, for the operating of any machine or automatic tools used in the erection, alteration, repair and dismantling of tanks and any and all "DUAL PURPOSE" trucks used on the construction job site.  
 GROUP 5: Oiler.

ENGI0825D 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
[STEEL ERECTION]:		
GROUP 1	33.39	14.90+A+B
GROUP 2	32.48	14.90+A+B

GROUP 3	30.19	14.90+A+B
GROUP 4	27.53	14.90+A+B
GROUP 5	26.00	14.90+A+B
GROUP 6	24.24	14.90+A+B
GROUP 7	34.75	14.90+A+B

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day.
- B. Employees receive 20% premium pay for hazardous waste work.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

[STEEL ERECTION]

- GROUP 1: Cranes - (all cranes, land or floating with booms including job 140 ft. and over, above ground); derricks-(all derricks, land or floating with boom including jib 140 ft. and over, above ground).
- GROUP 2: Cranes - (all cranes, land or floating with booms including jib less than 140 ft. above ground); derricks (all derricks, land or floating with booms including jib, less than 140 ft. above ground).
- GROUP 3: "A" frame; cherry pickers 10 tons and under; hoists; all types hoists shall also include steam, gas, diesel, electric, air hydraulic, single and double drum, concrete, brick shaft caisson, or any other similar type hoisting machines, portable or stationary, except Chicago boom type; jacks-screw air hydraulic power operated unit console type (not hand jack or pile load test type) side booms.
- GROUP 4: Aerial platform used hoist; compressor, 2 or 3 in battery; elevators or house cars; conveyors and tugger hoists; fireman; forklift; generators, 2 or 3 maintenance-utility man; rod bending machine (power); welding machines--(gas or electric, 2 or 3 in battery, including diesels); captain power boats; tug master power boats.
- GROUP 5: Compressor, single, welding machine, single, gas, electric converters of any type, diesel; welding system multiple (rectifier transformer type); generator, single.
- GROUP 6: Oiler staddle carrier.
- GROUP 7: Helicopter pilot.

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 ENGI0825E 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
OILOSTATIC MAINLINES & TRANSPORTATION PIPELINES:		
GROUP 1	31.25	14.90+A+B
GROUP 2	29.60	14.90+A+B
GROUP 3	27.46	14.90+A+B
GROUP 4	25.96	14.90+A+B
GROUP 5	24.24	14.90+A+B
GROUP 6	33.18	14.90+A+B

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day; Washington's Birthday, Memorial Day; Independence Day; Labor Day; Veteran's Day, Thanksgiving Day; and Christmas Day
- B. Employee receives 20% premium pay for hazardous waste work.

OILOSTATIC MAINLINES AND TRANSPORTATION PIPE LINES

CLASSIFICATIONS

- GROUP 1: Backhoe; cranes (all types); draglines; front-end

loaders (5 yds. and over); gradalls; scooper (loader and shovel); koehring and trench machines.

GROUP 2: "A" frame; backhoe (combination hoe loader); boring and drilling machines; ditching machine, small; ditchwitch or similar type; fork lifts; front end loaders (2 yds and over but less than 5 yds.); graders, finish (fine); hydraulic cranes, 10 tons and under (over 10 tons - crane rate applies); side booms; and winch trucks (hoisting).

GROUP 3: Backfiller; brooms and sweepers; bulldozers; compressors (2 or 3 in battery); front-end loaders (under 2 yds.); generators; giraffe grinders; graders and motor patrols; mechanic; pipe bending machine (power); tractors; water and sprinkler trucks, welder and repair mechanic.

GROUP 4: Compressor (single); dope pots (mechanical with or with out pump); dust collectors; farm tractors; pumps (4 in. suction and over); pumps (2 or less than 4 in. suction); pumps; diesel engine and hydraulic (immaterial or power); welding machines; gas or electric converters of any type, single; welding machines, gas or electric converters of any type, 2 or 3 in battery multiple welders; wellpoint systems (including installation and maintenance).

GROUP 5: Oiler, grease, gas, fuel and supply trucks and tire repair and maintenance.

GROUP 6: Helicopter-pilot.

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IRON0011B	07/01/1998		
		Rates	Fringes
MONMOUTH AND OCEAN COUNTIES			
IRONWORKERS:			
Structural & Ornamental		26.13	20.25
Reinforcing		24.63	20.25

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* IRON0068A	07/01/1999		
		Rates	Fringes
BURLINGTON (Remainder), MERCER, MONMOUTH (South half), AND OCEAN (Middle third) COUNTIES			
IRONWORKERS:			
Structual, Ornamental		26.56	18.85
Reinforcing (Concrete Rods)		24.56	18.85

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* IRON0350A	07/01/1999		
		Rates	Fringes
ATLANTIC, CAPE MAY, CUMBERLAND (Area East of a line drawn from Delaware Bay through the town of Cedarsville and upwards to the point where the county lines of Gloucester, Cumberland, and Atlantic meet), AND OCEAN (Remainder) COUNTIES			
IRONWORKERS:			
BUILDING CONSTRUCTION:			
Structural		26.45	16.85
Reinforcing		25.45	16.85
Fencing		23.80	16.85
HIGHWAY CONSTRUCTION:			
Reinforced Concrete		22.95	16.85
Structural		25.50	16.85

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IRON0399A	07/01/1998		
		Rates	Fringes

BURLINGTON (Southern portion up to but not including Lumberton and Chatsworth Twps.), CAMDEN, CUMBERLAND (Remainder), GLOUCESTER, AND SALEM COUNTIES

IRONWORKERS:

Structural, Ornamental, and Reinforcing	26.90	13.15
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LABO0050A 05/01/1999

	Rates	Fringes
MERCER COUNTY (Townships of Princeton, Lawrence, West Windsor, and Borough of Princeton)		

LABORERS (BUILDING CONSTRUCTION):

CLASS A	20.25	11.42
CLASS B	19.75	11.42
CLASS C	16.79	11.42

LABORERS CLASSIFICATIONS (BUILDING CONSTRUCTION)

CLASS A: Jack Hammer; Tamper; Motorized Tampers and Compactors Street Cleaning Machines; Scaffold Builder; Hydro Demolition Equipment; All types of Motorized Fork Lifts; Riding Motor Buggy Operator; Bob Cat Operator; Mortar Man; Burners; Nozzle Man on gunite Work.

CLASS B: All Laborers not listed in Class A or C.

Class C Laborers doing Janitorial type light clean up associated with the turnover of the project or part of a project to the owner; All Flagman; and those manning temporary heat of all types.

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LABO0172A 03/01/1999

	Rates	Fringes
ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, MERCER, OCEAN AND SALEM COUNTIES		

LABORERS:

GROUP 1	22.25	9.70+A
GROUP 2	22.45	9.70+A
GROUP 3	22.75	9.70+A
GROUP 4	22.95	9.70+A
GROUP 5	23.20	9.70+A
GROUP 6	26.75	9.70+A
GROUP 7	25.25	9.70+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day; Labor Day, Veteran's Day, Presidential Election Day, Thanksgiving Day, and Christmas Day, provided the employee works 3 days for the same Employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

LABORERS CLASSIFICATIONS

GROUP 1: Common laborers, landscape laborers, railroad track laborers, flagmen, salamander tenders, pitman, dumpman, waterproofing laborers, rakers and tampers on cold patch work, and wrapping and coating of all pipes.

GROUP 2: Powder carrier, magazine tender, and signalman.

GROUP 3: Sewer pipe, laser men, conduit and duct line layer, power tool operator, jack hammer, chipping hammer, pavement breaker, power buggy, concrete cutter, asphalt cutter, sheet

hammer and tree cutter operators, sandblasting cutting, burning and such other power tools used to perform work usually done manually by laborers.

GROUP 4: Wagon drill operator, timberman and drill master.

GROUP 5: Finisher, manhole, catch basin or inlet builder, form setter, rammer, paver, gunite nozzleman and stonecutter.

GROUP 6: Blaster.

GROUP 7: Hazardous waste laborer(Excludes asbestos work).

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LABO0172B 03/01/1999

	Rates	Fringes
LABORERS; FREE AIR TUNNEL:		
GROUP 1	26.70	9.70+A
GROUP 2	23.30	9.70+A
GROUP 3	23.15	9.70+A
GROUP 4	22.60	9.70+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day; Independence Day, Labor Day, Presidential Election Day, provided the employee works 3 days for the same Employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

LABORERS; FREE AIR TUNNEL CLASSIFICATIONS

GROUP 1: Blasterers.

GROUP 2: Skilled men (including miners, drill runners, iron men, maintenance men, conveyor men, safety miners, riggers, block layers, cement finishers, rod men, caulkers, powder carriers, all other skilled men).

GROUP 3: Semi-skilled men (including chuck tenders, track men, nippers, brakemen, derail men, cable men, hose men, grout men, gravel men, form men, bell or signal men (top or bottom), form workers and movers, concrete workers, shaft men, tunnel laborers all other semi-skilled).

GROUP 4: All others (including powder watchmen, change house attendants, top laborers).

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LABO0172C 03/01/1999

	Rates	Fringes
ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, MERCER, MONMOUTH, OCEAN, SALEM, AND MIDDLESEX (Southern half) COUNTIES		

LABORERS - ASPHALT CONSTRUCTION:

STREET:

Head Rakers	21.55	11.20+A
Rakers & Screed Men	21.40	11.20+A
Tampers, Smothers, Kettlemen, Painters, Shovelers and Roller Boys	21.15	11.20+A

PLANT:

Scale Mixers & Burner Men	21.40	11.20+A
Feeders and Dust Men	21.15	11.20+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day; Independence Day; Labor Day; Veteran's Day, Presidential Election Day, Thanksgiving Day, and

Christmas Day provided The Employee works 3 days for same employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

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LABO0222A 05/01/1999

BURLINGTON (Twps. of Cinnaminson, Delance, Delran, East Hampton, Edgewater Park, Evesham, Hainesport, Lumberton, Medford, Moorestown, Mount Laurel, Pemberton, Shamong, South Hampton, Tabernacle, West Hampton, Willingsboro and Woodland); CAMDEN; CUMBERLAND; GLOUCESTER; AND SALEM COUNTIES

LABORERS (BUILDING CONSTRUCTION):

	Rates	Fringes
CLASS A	18.42	13.25
CLASS B	17.92	13.25
CLASS C	15.23	13.25

LABORERS CLASSIFICATIONS (BUILDING CONSTRUCTION)

CLASS A: Jack Hammer, Tamper, Motorized Tampers and Compactors, Street Cleaning Machines, Scaffold Builder, Hydro, Demolition Equipment, All types of Motorized Fork Lifts Riding Motor Buggy Operator, Bobcat Operator, Mortar Man, Burners, Nozzle Man on Gunite work.

CLASS B: All laborers not listed in Class A or C.

CLASS C: Laborers doing Janitorial-type light clean up work associated with the turnover of the project to the owner All Flagman, and those manning temporary heat of all types.

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LABO0343A 05/01/1999

MERCER (Twps. of East Windsor, Hightown, and Washington); MONMOUTH; AND OCEAN (Remainder) COUNTIES

LABORERS:

	Rates	Fringes
Class A	18.70	13.00
Class B	18.20	13.00
Class C	15.47	13.00

LABORER CLASSIFICATIONS

Class A: Jack Hammer; Tamper; Motorized Tampers & Compactors; Street Cleaning Machines; Scaffold Builder; Hydro Demolition Equipment; all types of Motorized Fork Lifts; Riding Motor Buggy Operator; Bobcat Operator Mortar Man; Burners; Nozzle Man on Gunite work.

Class B: All laborers not listed in Class A or C.

Class C: Laborers doing Janitorial-type light clean up work associated with the turnover of the project to the owner, All flagman, and those manning temporary heat of all types.

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LABO0369A 05/01/1999

BURLINGTON (Remainder); and MERCER (Remainder)  
LABORERS

	Rates	Fringes
	19.30	11.87

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LABO0415A 05/01/1999

ATLANTIC; BURLINGTON (Twps. of Bass River and Washington); CAPE MAY; CUMBERLAND (Twps. of Commercial, Dawne, Fairfiled, Lawrence,

Maurce, and Millville); AND OCEAN (That portion up to and including Lacy Twp.) COUNTIES

LABORERS (BUILDING CONSTRUCTION):

CLASS A	19.75	11.95
CLASS B	19.25	11.95
CLASS C	16.36	11.95

LABORERS CLASSIFICATIONS (BUILDING CONSTRUCTION)

CLASS A: Jack Hammer, Tamper, Motorized Tampers and Compactors, Street Cleaning Machines, Scaffold Builder, Hydro Demolition Equipment, all types of Motorized Fork Lifts, Riding Motor Buggy Operator, Bobcat Operator, Mortar Man, Burners, Nozzle Man on Gunite work.

CLASS B: All laborers not listed in Class A or C.

CLASS C: Laborers doing Janitorial- type light clean up work associated with the turnover of the project to the owner All flagman, and those manning temporary heat of all types.

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LABO0472A 09/01/1997

	Rates	Fringes
MONMOUTH COUNTY		
LABORERS (HEAVY AND HIGHWAY CONSTRUCTION):		
GROUP 1	21.20	9.00+A
GROUP 2	21.40	9.00+A
GROUP 3	21.70	9.00+A
GROUP 4	21.90	9.00+A
GROUP 5	22.15	9.00+A
GROUP 6	25.70	9.00+A
GROUP 7a	24.20	9.00+A
Group 7b	22.20	9.00+A

LABORERS CLASSIFICATIONS (HEAVY & HIGHWAY)

GROUP 1: Common laborers, landscape laborers, railroad track laborers, flagmen, salamander tenders, pitman, dumpman, waterproofing laborers, rakers and tampers on cold patch work, and wrapping and coating of all pipes, & Asphalt Laborers.

GROUP 2: Powder carrier, magazine tender, signalman, asphalt raker, and asphalt screedman

GROUP 3: Sewer pipe, laser men, conduit and duct line layer, power tool operator, jack hammer, chipping hammer, pavement breaker, power buggy, concrete cutter, asphalt cutter, sheet hammer and tree cutter operators, sandblasting cutting, burning, power tool operator, and such other power tools used to perform work usually done manually by laborers.

GROUP 4: Wagon drill operator, timberman and drill master.

GROUP 5: Finisher, manhole, catch basin or inlet builder, form setter, rammer, paver, gunite nozzleman, and stone cutter

GROUP 6: Blaster.

Group 7a: Hazardous waste laborer required to wear level A,B, or C personal protection.

GROUP 7b: Certified laborer working a hazardous waste removal project or site at a task requiring hazardous waste related certification, but who is not working in a zone requiring level A,B, or C personal protection.

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day,

Veteran's Day, Presidential Election Day, Thanksgiving Day,  
 and Christmas Day provided the employee works 3 days for  
 the same employer within a period of 10 working days  
 consisting of 5 working days before and 5 working days  
 after the day upon which the holiday falls or is observed

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 LABO1030A 04/01/1998

	Rates	Fringes
LABORERS: (The removal, abatement, enclosure and decontamination of personal protective equipment, chemical protective clothing and machinery relating to asbestos and/or toxic and hazardous waste of materials which shall include but not necessarily be limited to: the erection, moving, servicing and dismantling to all enclosures, scaffolding, barricades, and the operation of all tools and equipment normally used in the removal or abatement of asbestos and toxic and hazardous waste or materials, the labeling, bagging, cartoning, crating, or other packaging of materials for disposal; and the clean up of the work site and all other work incidental to the removal, abatement, encapsulation, enclosure, and decontamination of asbestos or toxic and hazardous waste materials; and in addition, all work tasks involved in the maintenance and operation of energy resource recover plants (co-generation plants).)		
LABORERS	19.70	9.60

-----  
 PAIN0252H 06/01/1998

	Rates	Fringes
ATLANTIC, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, SALEM, and parts of BURLINGTON and OCEAN (everything south of these cities in Burlington and Ocean Counties-Florence to Bustleton to Columbus to Jobstown to Pemberton to Onga Hat to Chatsworth to Whiting to Pinewald to Ocean Gate to Seaside Heights) COUNTIES:		
GLAZIERS	\$23.20	9.78

-----  
 PAIN0711A 05/01/1999

	Rates	Fringes
ATLANTIC, CAPE MAY, & OCEAN ( Municipalities of Eaglewood, Little Egg Harbor, Ocean, Stafford, & Union) COUNTIES:		
PAINTING, PAPERHANGING & ALLIED WORK	28.25	2.54+27%
SPRAYING, SANDBLASTING, DIPPING, POWER TOOLS (Over 115 volts) & PAPERHANGING PASTING APPARATUS WORK ON TANKS, BRIDGES, TOWERS, STACKS, & OPEN STRUCTURAL STEEL, WORK FROM CABLES & SWINGING SCAFFOLDS, EXTERIOR WORK ABOVE THREE STORIES	30.75	2.54+27%
REPAINT WORK & PREPARATION THEREFORE (including jobs where no major alterations are taking place but excluding bridges,		

7	stacks, elevated tanks & generating		
8	stations)	21.80	2.54+27%
9	-----		
0			
1	PAIN0711B 05/01/1999		
2		Rates	Fringes
3	MONMOUTH & OCEAN (excluding the municipalities of Eaglewood,		
4	Little Egg Harbor, Ocean, Stafford, & Union) COUNTIES:		
5			
6	PAINTING, PAPERHANGING & ALLIED WORK	28.25	2.54+27%
7			
8	SPRAYING, SANDBLASTING, DIPPING,		
9	POWER TOOLS (Over 115 volts) &		
0	PAPERHANGING PASTING APPARATUS		
1	WORK ON TANKS, BRIDGES, TOWERS,		
2	STACKS, & OPEN STRUCTURAL STEEL,		
3	WORK FROM CABLES & SWINGING SCAFFOLDS,		
4	EXTERIOR WORK ABOVE THREE STORIES		
5		30.75	2.54+27%
6			
7	REPAINT WORK & PREPARATION THEREFORE		
8	(including jobs where no major alterations		
9	are taking place but excluding bridges,		
0	stacks, elevated tanks & generating		
1	stations)	21.80	2.54+27%
2	-----		
3			
4	PAIN0711C 05/01/1999		
5		Rates	Fringes
6	BURLINGTON, CAMDEN, GLOUCESTER, & SALEM COUNTIES:		
7			
8	PAINTING, PAPERHANGING & ALLIED WORK	28.25	2.54+27%
9			
0	SPRAYING, SANDBLASTING, DIPPING,		
1	POWER TOOLS (Over 115 volts) &		
2	PAPERHANGING PASTING APPARATUS		
3	WORK ON TANKS, BRIDGES, TOWERS,		
4	STACKS, & OPEN STRUCTURAL STEEL,		
5	WORK FROM CABLES & SWINGING SCAFFOLDS,		
6	EXTERIOR WORK ABOVE THREE STORIES		
7		30.75	2.54+27%
8			
9	REPAINT WORK & PREPARATION THEREFORE		
0			
1	(including jobs where no major alterations		
2	are taking place but excluding bridges,		
3	stacks, elevated tanks & generating		
4	stations)	21.80	2.54+27%
5	-----		
6			
7	PAIN0711H 05/01/1999		
8		Rates	Fringes
9	MERCER COUNTY		
0			
1	PAINTERS:		
2			
3	New Construction and		

4	Major Alterations	27.40	27%+2.54
5			
6	Repaint Work	21.80	27%+2.54
7			
8	Spraying or application of		
9	Hazardous or Dangerous		
0	Materials on Repaint Work	23.80	27%+2.54
1			
2	Bridges, TV & Radio Towers,		
3	Structural Steel & Tanks above 3		
4	stories in height (30' or over),		
5	Smoke Stacks, Water Towers, Sand-		
6	Blasting, Steam Cleaning, Spraying,		
7	or application of Hazardous		
8	Materials	31.00	27%+2.54
9			
0	Paperhanging	25.60	27%+2.54
1	-----		
2			
3	PAIN0711J 06/01/1998		
4		Rates	Fringes
5	DRYWALL FINISHERS	27.75	10.72
6	-----		
7			
8	PAIN0711K 05/01/1999		
9		Rates	Fringes
0	MERCER & MONMOUTH COUNTIES:		
1			
2	GLAZIERS:	28.25	10.19
3	-----		
4			
5	PAIN1009A 10/01/1996		
6		Rates	Fringes
7	MIDDLESEX, SOMERSET (Basking Ride, Bernardsville, and Watchung),		
8	AND UNION (Carteret, Port Reading, Fords and Woodbridge) COUNTIES		
9			
0	GLAZIERS	26.15	9.65
1	-----		
2			
3	PAIN1976A 08/01/1998		
4		Rates	Fringes
5	ATLANTIC, BURLINGTON, CAPE MAY, CUMBERLAND, MERCER, MONMOUTH		
6	AND OCEAN COUNTIES		
7			
8	DRYWALL TAPERS & FINISHERS	27.75	10.72
9	-----		
0			
1	PLAS0699A 05/01/1998		
2		Rates	Fringes
3	CAMDEN, GLOUCESTER, AND SALEM COUNTIES		
4			
5	CEMENT MASONS	23.75	11.00
6	-----		
7			
8		NJ990002 - 1	
9	PLUM0009I 03/01/1999		
0		Rates	Fringes

1 AIR CONDITIONING & REFRIGERATION

2 MECHANICS 22.08 7.57

3

4 SCOPE OF WORK:

5 Installation of air conditioning and refrigeration equipment  
6 whose combined tonnage does not exceed 15 tons. Installation of  
7 water cooled air conditioning that does not exceed 10 tons  
8 (includes piping of component system and erection of water  
9 tower). Installation of air cooled air conditioning that does  
0 not exceed 15 tons. Installation of air conditioning equipment  
1 of the "Package-Unitary" rooftop type, the combined tonnage of  
2 which does not exceed 35 tons. Packaged Unitary Air Conditioning  
3 and Refrigeration Institute (ARI) as follows: "A unitary air  
4 conditioner consists of one or more cooling coil, and air moving  
5 device, a compressor and condenser combination, and may include a  
6 heating function as well". Any and all related piping to the  
7 above installation will be done under the appropriate trade  
8 jurisdiction.

9 -----

0

1 PLUM0009J 07/01/1998

2 Rates Fringes

3 BURLINGTON (Remainder), MERCER, MONMOUTH, AND OCEAN COUNTIES:

4

5 PLUMBERS & PIPEFITTERS 29.58 13.85

6 -----

7

8 PLUM0322A 05/01/1999

9 Rates Fringes

0 ATLANTIC; BURLINGTON (The portion of County which includes  
1 Atsion, Bass, River Twp., Batsto, Chatsworth, Green Bank, Herman,  
2 Jenkins, New Gretna, Quaker Bridge, Wading River, Washington and  
3 Woodland Twps; the portion of the County starting on the West by  
4 the Delaware River, on the North by a line following the center  
5 of High Street to the Pennsylvania Railroad running from Camden  
6 to Mt. Holly, Birmingham, Seaside Park and shore points on the  
7 Jersey coast and along aforesaid Railroad to the Town of  
8 Whitings; Thence diagonally across Burlington County to the  
9 Junction of Burlington, Camden, and Atlantic Counties); CAMDEN;  
0 CAPE MAY; CUMBERLAND; GLOUCESTER; AND SALEM COUNTIES

1

2 PLUMBERS/PIPEFITTERS 26.46 15.10

3 -----

4

5 ROOF0004A 06/01/1996

6 Rates Fringes

7 MONMOUTH COUNTY (Remainder), AND OCEAN COUNTIES

8

9 ROOFERS 24.22 11.75

0 -----

1

2 ROOF0030D 05/01/1999

3 Rates Fringes

4 ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER,  
5 MERCER AND SALEM COUNTIES; and the following portions of MONMOUTH  
6 AND OCEAN COUNTIES: West of a line starting from the point on  
7 Route 70 where Burlington and Ocean Counties meet, Easterly along

8 Route 70 to Route 571, along Route 571 to Cassville, Easterly on  
 9 Route 528 to Van Hiseville, Northerly on Route 527 to Manalapan,  
 0 Westerly on Route 33 to the Monmouth County Line

1			
2	ROOFERS:		
3	Shingle, slate and tile	19.25	6.17
4	All other work	24.15	12.15+A
5			

6 FOOTNOTE:  
 7 A. PAID HOLIDAY: Election Day.

8 -----

9  
 0 SFNJ0669B 04/01/1999

1		Rates	Fringes
2	ATLANTIC, BURLINGTON, CAPE MAY, CUMBERLAND, MERCER (Remainder),		
3	MONMOUTH, OCEAN, AND SALEM (Remainder) COUNTIES		
4			
5	SPRINKLER FITTERS	30.65	6.40
6			

6 -----

7  
 8 SFNJ0692C 05/01/1998

9		Rates	Fringes
0	CAMDEN, GLOUCESTER, MERCER (Town of Trenton), AND SALEM (Penns		
1	Grove, excluding Penns Grove Airport) COUNTIES		
2			
3	SPRINKLER FITTERS	29.97	9.40
4			

4 -----

5  
 6 SHEE0019M 05/01/1999

7		Rates	Fringes
8	CAMDEN, GLOUCESTER, & SALEM COUNTIES:		
9			
0	SHEET METAL WORKER	26.97	15.11+H
1			

2 H-Election Day is a paid holiday.

3 -----

4  
 5 SHEE0027B 06/01/1997

6		Rates	Fringes
7	ATLANTIC, BURLINGTON, CAPE MAY, CUMBERLAND, MERCER, MONMOUTH AND		
8			
9	OCEAN COUNTIES		
0			
1	SHEET METAL WORKERS	28.20	13.59
2			

2 -----

3  
 4 SUNJ1002A 12/07/1993

5		Rates	Fringes
6	MERCER COUNTY		
7			
8	CEMENT MASONS (BUILDING		
9	CONSTRUCTION ONLY)	19.60	8.83
0			

0 -----

1  
 2 TEAM0331A 01/01/1998

3		Rates	Fringes
4	ATLANTIC AND CAPE MAY COUNTIES		

5  
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TRUCK DRIVERS:

GROUP 1	20.75	8.92+A
GROUP 2	20.90	8.92+A
GROUP 3	21.10	8.92+A
GROUP 4	21.25	8.92+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day; Washington's Birthday; Memorial Day; Independence Day; Labor Day; Veteran's Day; Presidential Election Day; Thanksgiving Day; & Christmas Day; provided the employee works 3 days in the week in which the holiday falls.

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: Striaight Truck Driver, Dump Truck Driver, Water Truck Driver, Transit Mix Driver, Pickup Truck Driver, Tank Truck Driver, Track Truck Driver, Agitator Truck Driver, Concrete Mobile Unit Driver, Tringer Bead Truck Driver, Ross Carrier Driver, Warehouse Forklift Driver, A Frame Truck Driver, Gin Pole Truck Driver, Form Truck Driver, Driver for Truck having Self Loading/Unloading Attachment, & Vacuum Truck/Trailer.

GROUP 2: Trucks Towing Driver

GROUP 3: Trailer Truck Driver, Winch Truck Driver, Off Road Dump Truck Driver, Fuel Truck Driver, Tractor Trailer (any trailer driver), Asphalt Oil Distributor Driver, & Off Road Water Truck Driver.

GROUP 4: Mechanics.

GROUP 2: Drivers on Euclids, 10 Wheel Tractors and Tractor Trailer Trucks, Low Bed, and Pole Trailers

TEAM0469D 05/01/1997

BURLINGTON (Remainder), MERCER, MONMOUTH, AND OCEAN COUNTIES

TRUCK DRIVERS:

GROUP 1	24.45	10.335+A
GROUP 2	24.50	10.335+A
GROUP 3	24.60	10.335+A
GROUP 4	24.70	10.335+A

FOOTNOTE:

A. Employees working or receiving pay for 80 days within a year receive one week's paid vacation (48 hours); 125 days receive two weeks' vacation (96 hours); 145 days receive 15 days (120 hours); 15 years seniority and 145 days receive 4 weeks vacation (160 hours).

PAID HOLIDAYS: New Year's Day; Washington's Birthday; Memorial Day; Independence Day; Labor Day; Columbus Day; Veteran's Day, General Election Day; Thanksgiving Day; and Christmas Day provided the employee has been assigned to work or "shapes" one day of the calendar week during which the holiday falls. Employee receives \$3.00 per hour premium pay for hazardous waste work.



9 GROUP 5 20.75 8.1875+A+B  
0 GROUP 6 \*

1

2 FOOTNOTES:

3 A. Employee who has worked or received pay for 90 days  
4 within a year prior to his anniversary date shall  
5 receive 56 hours straight time vacation pay; for 3 years  
6 but less than 8 years of service he will receive 100  
7 hours of straight time vacation pay; 15 years or more he  
8 will receive 165 hours of straight time vacation pay.

9 B. PAID HOLIDAYS: New Year's Day, Memorial Day,  
0 Independence Day, Labor Day, Veteran's Day,  
1 Presidential Election Day, Thanksgiving Day, Christmas  
2 Day, and two personal holidays, Good Friday, and  
3 Christmas Eve afternoon (provided employee works that  
4 morning) on the condition that the employee works or is  
5 available for work on at least two days in the week in  
6 which the holiday occurs.

7

8 TRUCK DRIVERS CLASSIFICATIONS

9

0 GROUP 1: Warehouseman

1

2 GROUP 2: Dump truck, water truck, transit mix, pickup, tank,  
3 track, agitator, concrete mobile unit, dytinger bead, tack  
4 rig, ross carrier, warehouse forklift, A-frame, gin pole  
5 form truck, truck having self-loading/unloading attachment,  
6 straight

7

8 GROUP 3: Truckstowing

9

0 GROUP 4: Trailer winch off road dump, fuel, tractor trailer,  
1 asphalt oil distributor, off road water truck

2

3 GROUP 5: Mechanics

4

5 \*GROUP 6: Truck drivers, on hazardous waste removal work on a  
6 state or federally designated hazardous waste site where  
7 the truck driver is in direct contact with hazardous  
8 materials and when personal protective equipment is  
9 required for respiratory, skin and eye protection  
0 the teamster shall receive \$2.25 per hour in addition to  
1 the regular rate of pay including overtime pay.

2 -----

3

4 WELDERS - Receive rate prescribed for craft performing operation  
5 to which welding is incidental.

6 =====

7

8 Unlisted classifications needed for work not included within  
9 the scope of the classifications listed may be added after  
0 award only as provided in the labor standards contract clauses  
1 (29 CFR 5.5(a)(1)(v)).

2 -----

3 In the listing above, the "SU" designation means that rates  
4 listed under that identifier do not reflect collectively  
5 bargained wage and fringe benefit rates. Other designations

6 indicate unions whose rates have been determined to be  
7 prevailing.

8  
9 WAGE DETERMINATION APPEALS PROCESS  
0

1 1.) Has there been an initial decision in the matter? This can  
2 be:

- 3  
4 \* an existing published wage determination  
5 \* a survey underlying a wage determination  
6 \* a Wage and Hour Division letter setting forth a  
7 position on a wage determination matter  
8 \* a conformance (additional classification and rate)  
9 ruling  
0

1 On survey related matters, initial contact, including requests  
2 for summaries of surveys, should be with the Wage and Hour  
3 Regional Office for the area in which the survey was conducted  
4 because those Regional Offices have responsibility for the  
5 Davis-Bacon survey program. If the response from this initial  
6 contact is not satisfactory, then the process described in 2.)  
7 and 3.) should be followed.

8  
9 With regard to any other matter not yet ripe for the formal  
0 process described here, initial contact should be with the Branch  
1 of Construction Wage Determinations. Write to:

2  
3 Branch of Construction Wage Determinations  
4 Wage and Hour Division  
5 U. S. Department of Labor  
6 200 Constitution Avenue, N. W.  
7 Washington, D. C. 20210  
8

9 2.) If the answer to the question in 1.) is yes, then an  
0 interested party (those affected by the action) can request  
1 review and reconsideration from the Wage and Hour Administrator  
2 (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

3  
4 Wage and Hour Administrator  
5 U.S. Department of Labor  
6 200 Constitution Avenue, N. W.  
7 Washington, D. C. 20210  
8

9 The request should be accompanied by a full statement of the  
0 interested party's position and by any information (wage payment  
1 data, project description, area practice material, etc.) that the  
2 requestor considers relevant to the issue.

3  
4 3.) If the decision of the Administrator is not favorable, an  
5 interested party may appeal directly to the Administrative Review  
6 Board (formerly the Wage Appeals Board). Write to:

7  
8 Administrative Review Board  
9 U. S. Department of Labor  
0 200 Constitution Avenue, N. W.  
1 Washington, D. C. 20210  
2



## SECTION 01000

## Description of Bid Items

The general outline of the principal features of the each item as listed above does not in any way limit the responsibility of the bidder for making a through investigation of the drawings and the specifications to determine the scope of work including each item of the bidding schedule.

Descriptions of the bid items are supplemented as follows:

(a) Item No. 0001(1) "Add/Alt. Building 208", includes all work required, within the lines 5 feet outside the building lines, except that work covered by Item No. 0002(1).

(b) Item No. 0002(1) "Site Improvements", includes all work required 5 feet beyond the building lines.

(c) Item No. 0003(1) "OMAR Equipment", includes all work required to furnish and install items indicated as "OMAR funded" on the drawings or in the Specifications. OMAR (Operation and Maintenance Army Reserve) equipment is to be contractor provided and installed.

OMAR funded equipment consists of:

Metal storage Shelving (specification section 10552)  
Wire Mesh Partitions (specifications section 10605)  
Trash & Ash Receptacles (specification section 10990)  
Break Room Refrigerator & Microwave (specification section 11400)  
Telephone Instruments (specification section 16741)

## SECTION 01090

## SOURCES FOR REFERENCE PUBLICATIONS

## PART 1 GENERAL

## 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the sponsoring organization, e.g.

UL 1 (1993; Rev thru Jan 1995) Flexible Metal Conduit. However, when the sponsoring organization has not assigned a number to a document, an identifying number has been assigned for convenience, e.g. UL's unnumbered 1995 edition of their Building Materials Directory is identified as UL-01 (1995) Building Materials Directory. The sponsoring organization number (UL 1) can be distinguished from an assigned identifying number (UL-01) by the lack of a dash mark (-) in the sponsoring organization assigned number.

## 1.2 ORDERING INFORMATION

The addresses of the organizations whose publications are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the sponsoring organization should be ordered from the source by title rather than by number.

## ACI INTERNATIONAL (ACI)

P.O. Box 9094  
Farmington Hills, MI 48333-9094  
Ph: 248-848-3800  
Fax: 248-848-3801  
Internet: <http://www.aci-int.org>

## AGRICULTURAL MARKETING SERVICE (AMS)

Seed Regulatory and Testing Branch  
USDA, AMS, LS Div.  
Room 209, Bldg. 306, BARC-East  
Beltsville, MD 20705-2325  
Ph: 301-504-9430  
Fax: 301-504-5454 Internet: <http://www.ams.usda.gov/lsg/ls-sd.htm>  
e-mail: [james\\_p\\_tripplitt@usda.gov](mailto:james_p_tripplitt@usda.gov)

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

4301 North Fairfax Dr., Suite 425  
ATTN: Pubs Dept.  
Arlington, VA 22203  
Ph: 703-524-8800  
Fax: 703-528-3816  
E-mail: [ari@ari.org](mailto:ari@ari.org)  
Internet: [www.ari.org](http://www.ari.org)

## AIR DIFFUSION COUNCIL (ADC)

104 So. Michigan Ave., No. 1500  
Chicago, IL 60603

Ph: 312-201-0101  
 Fax: 312-201-0214

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

30 W. University Dr.  
 Arlington Heights, IL 60004-1893  
 Ph: 708-394-0404  
 Fax: 708-253-0088

ALUMINUM ASSOCIATION (AA)

Pubs Department  
 P.O. Box 753  
 Waldorf, MD 20601  
 Ph: 301-645-0756  
 Fax: 301-843-0159  
 Internet: www.aluminum.org

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

1827 Walden Ofc. Sq.  
 Suite 104  
 Schaumburg, IL 60173-4268  
 Ph: 847-303-5664  
 Fax: 847-303-5774  
 Internet: www.aamanet.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

444 N. Capital St., NW, Suite 249  
 Washington, DC 20001  
 Ph: 800-231-3475  
 Fax: 800-525-5562  
 Internet: www.aashto.org  
 NOTE: AASHTO documents with numbers beginning with M or T are available only in Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1997 @\$289.00\X

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

P.O. Box 12215  
 1 Davis Drive  
 Research Triangle Park, NC 27709-2215  
 Ph: 919-549-8141  
 Fax: 919-549-8933

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

1200 19th Street, NW, Suite 300  
 Washington, DC 20036-4303  
 Ph: 202-429-5155  
 Fax: 202-223-4579

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

1330 Kemper Meadow Dr.  
 Cincinnati, OH 45240  
 Ph: 513-742-2020  
 Fax: 513-742-3355

AMERICAN HARDBOARD ASSOCIATION (AHA)

1210 W. Northwest Highway  
Palatine, IL 60067  
Ph: 708-934-8800  
Fax: 708-934-8803

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

One East Wacker Dr., Suite 3100  
Chicago, IL 60601-2001  
Ph: 312-670-2400  
Publications: 800-644-2400  
Fax: 312-670-2400  
Internet: <http://www.aiscweb.com>

## AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

7012 So. Revere Parkway, Suite 140  
Englewood, CO 80112  
Ph: 303-792-9559  
Fax: 303-792-0669

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

ATTN: Publication Orders  
P.O. Box 4321  
Chestertown, MD 21690  
Ph: 800-277-3850  
Fax: 410-810-0910

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

11 West 42nd St  
New York, NY 10036  
Ph: 212-642-4900  
Fax: 212-398-0023  
Internet: [www.ansi.org/](http://www.ansi.org/)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

100 Barr Harbor Drive  
West Conshohocken, PA 19428-2959  
Ph: 610-832-9500  
Fax: 610-832-9555  
Internet: [www.astm.org](http://www.astm.org)  
NOTE: The annual ASTM Book of Standards (66 Vol) is  
available for \$3500.00. Prices of individual standards vary.

## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

1801 Alexander Bell Drive  
Reston, VA 20190-4400  
Ph: 800-548-2723  
Fax: 703-295-6333  
Internet: [www.pubs.asce.org](http://www.pubs.asce.org)  
e-mail: [marketing@asce.org](mailto:marketing@asce.org)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

1791 Tullie Cir., NE  
Atlanta, GA 30329-2305  
Ph: 800-527-4723 or 404-636-8400  
Fax: 404-321-5478  
Internet: <http://www.ashrae.org>

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

P.O. Box 40362  
Bay Village, OH 44140  
Ph: 216-835-3040  
Fax: 216-835-3488  
E-mail: asse@ix.netcom.com

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

6666 West Quincy  
Denver, CO 80235  
Ph: 800-926-7337  
Fax: 303-795-1989  
Internet: www.awwa.org

## AMERICAN WELDING SOCIETY (AWS)

550 N.W. LeJeune Road  
Miami, FL 33126  
Ph: 305-443-9353  
Fax: 305-443-7559  
Internet: http://www.amweld.org

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

3246 Fall Creek Highway, Suite 1900  
Grandbury, TX 76049-7979  
Ph: 817-326-6300  
Fax: 817-326-6306  
NOTE: AWPA Book of Standards is published yearly @\$75.00;  
individual standards may be ordered separately for \$12.00 to  
\$28.00 each.

## APA - THE ENGINEERED WOOD ASSOCIATION (APA)

2130 Barrett Park Dr., Suite 102  
Kennesaw, GA 30144-3681  
Ph: 770-427-9371  
Fax: 770-423-1703  
Internet: www.apawood.org  
Note: Prices are available only by calling APA

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

1952 Isaac Newton Square  
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-- End of Section --

## SECTION 01300

## SUBMITTAL PROCEDURES

## PART 1 GENERAL

## 1.1 SUMMARY

This section covers procedures to be used in making submittals called for in the contract documents. In contracts which contain specific "Contractor Quality Control" requirements, the Contractor's Quality Control Representative shall carry out duties associated with submittal procedures. In contract which do not contain specific CQC requirements, reference to "CQC Representative" shall be interpreted as reference to the Contractor's authorized representative, and references to "CQC Requirements" or "CQC Clauses" shall be interpreted as "requirements or clauses elsewhere in the contract."

## 1.2 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers as follows:

SD-01 Data

SD-04 Drawings

SD-06 Instructions

SD-07 Schedules

SD-08 Statements

SD-09 Reports

SD-13 Certificates

SD-14 Samples

SD-18 Records

SD-19 Operation and Maintenance Manuals

## 1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

## 1.3.1 Government Approved (GA)

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

### 1.3.2 Information Only (FIO)

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

### 1.4 REVIEWER CODES

Reviewer codes on the Submittal Register (ENG Form 4288) are identified as follows:

A - Area Engineer

E - Engineering (Design Branch)

AE- Architect/Engineer

### 1.5 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

### 1.6 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

### 1.7 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready

determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

### 3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of this section is one set of ENG Form 4288 listing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. Columns "d" through "r" have been completed by the Government; the Contractor shall complete columns "a" and "s" through "u" and submit the forms (hard copy plus associated electronic file) to the Contracting Officer for approval within 30 calendar days after Notice to Proceed (15 days if construction time is 180 days or less). If the Government supplies the ENG Form 4288 on the Resident Management System (RMS) electronic format, the contractor will be required to process and update the 4288 electronically, and make appropriate electronic submissions to the Government. Otherwise, the Contractor will be given the submittal register as a diskette containing the computerized ENG Form 4288 and instructions on the use of the diskette. In both cases, the Contractor shall update the 4288 electronically, and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated.

### 3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 10 calendar days shall be allowed and shown on the register for review and approval of submittals for food service equipment, refrigeration and HVAC control systems, computer software for specialty systems, electrical substations, and studies including electrical system coordination studies.

### 3.4 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be

properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item. If the contractor is required in another section of the specifications to utilize the RMS system, the contractor will be required to generate and process this form electronically using the RMS system.

### 3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

#### 3.5.1 Procedures

At the Quality Control Coordination meeting, or preconstruction conference, the Contractor shall ascertain the name and address of each individual, agency, or firm who is designated to normally receive items for approval, for information or samples. The contractor shall complete ENG Form 4025, entering each item requiring a separate approval action as a separate item on the form, for each transmittal. A transmittal may consist of one or more 4025 sheets. The transmittal, consisting of ENG Form 4025 plus all applicable submittals, is then sent to the appropriate individual. On critical items the Contractor is encouraged to confirm receipt via telephone. The Contractor shall submit seven copies of submittals for approval and one for items for information.

#### 3.5.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

### 3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control its procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

### 3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four copies of the submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

### 3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring

removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR  (Firm Name)
  _____ Approved
  _____ Approved with corrections as noted on submittal data and/or attached sheets(s).
SIGNATURE: _____
TITLE: _____
DATE: _____

SECTION 01310

PROJECT SCHEDULE:  
NETWORK ANALYSIS SYSTEM

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-07 Schedules

Initial Project Schedule; GA. Preliminary Project Schedule; GA. Periodic Schedule Updates; GA.

Four copies of the schedules showing codes, values, categories, numbers, items, etc., as required.

SD-08 Statements

Qualifications; FIO.

Documentation showing qualifications of personnel preparing schedule reports.

SD-09 Reports

Narrative Report; FIO. Schedule Reports; FIO.

Four copies of the reports showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports. This person shall have previously created and reviewed computerized schedules. Qualifications of this individual shall be submitted to the Contracting Officer for review with the Preliminary Project Schedule submission.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project should also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid

in evaluating time extensions, and to provide the basis of all progress payments.

### 3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel shall result in an inability of the Contracting Officer to evaluate Contractor progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

### 3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

#### 3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in either the Precedence Diagram Method (PDM) or the Arrow Diagram Method (ADM).

#### 3.3.2 Level of Detail Required

With the exception of the initial and preliminary schedule submission, the Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

##### 3.3.2.1 Activity Durations

Contractor submissions shall be required to follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods. A rule of thumb, that the Contractor should use, is that less than 2 percent of all non-procurement activities' Original Durations shall be greater than 20 days.

##### 3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

### 3.3.2.3 Government Activities

Government and other agencies activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and notice to proceed for phasing requirements.

### 3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

### 3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

### 3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number.

### 3.3.2.8 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

### 3.3.2.9 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not be allowed to contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

### 3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

## 3.3.3 Scheduled Project Completion

The schedule interval shall extend from notice-to-proceed to the contract completion date.

### 3.3.3.1 Project Start Date

The schedule shall start no earlier than the date that the Notice to Proceed (NTP) was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have: a "ES" constraint, a constraint date

equal to the date that the NTP was acknowledged, and a zero day duration.

### 3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity call "End Project". The "End Project" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

### 3.3.3.3 Early Project Completion

In the event the project schedule shows completion, the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted at every project schedule update period to assist the Contracting Officer to evaluate the Contractor's ability to actually complete prior to the contract period.

### 3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

#### 3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have: a "ES" constraint, a constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

#### 3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

#### 3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X:" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

### 3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in progress or completed activity and insure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes.

### 3.3.6 Out-of-Sequence Progress

Activities that have posted progress without predecessors being completed (Out-of-Sequence Progress) shall be allowed only by the case-by-case approval of the Contracting Officer. The Contracting Officer may direct that changes in schedule logic be made to correct any or all out-of-sequence work.

### 3.3.7 Extended Non-Work Periods

Designation of Holidays to account for non-work periods of over 5 days shall not be allowed. Non-work periods of over 5 days shall be identified by addition of activities that represent the delays. Modifications to the logic of the project schedule shall be made to link those activities that may have been impacted by the delays to the newly added delay activities.

### 3.3.8 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

## 3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

### 3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 10 calendar days after Notice to Proceed is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after Notice to Proceed.

### 3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after Notice to Proceed. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

### 3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer or to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

## 3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the initial submission, and every periodic project schedule update throughout the life of the project:

### 3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on

the disks shall be in the format specified in Appendix A, " Standard Data Exchange Format".

#### 3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the MS-DOS Version 5.0 operating system.

#### 3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the MS-DOS version used to format the disk.

#### 3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will insure that the names of the files submitted are unique. the Contractor shall submit the file naming convention to the Contracting Officer for approval.

#### 3.5.2 Narrative Report

A Narrative Report shall be provided with each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 4 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken.

#### 3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

#### 3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in-progress or completed.

##### 3.5.4.1 Activity Report

A list of all activities sorted according to activity number or "I-NODE" AND "J-NODE" and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

##### 3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

##### 3.5.4.3 Total Float Report

A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates.

#### 3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: [Activity Number] [or] ["i-node" and "j-node"], Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), Earnings to Date.

#### 3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on bi-monthly (60 days) schedule update submissions. In addition to other submission requirements, a single mylar reproduceable 20 inch by 30 inch size shall be submitted. The diagram shall also The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

##### 3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram.

##### 3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

##### 3.5.5.3 Critical Path

The critical path shall be clearly shown.

##### 3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

##### 3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

#### 3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly on-site meeting or other regular intervals mutually agreed to at the

preconstruction conference. During this meeting the Contractor will describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

### 3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

### 3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

### 3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost to Date shall be subject to the approval of the Contracting Officer. The following minimum set of items which the Contractor shall address, on an activity by activity basis, during each progress meeting.

#### 3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed activities.

#### 3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations must be based on Remaining Duration for each activity.

#### 3.6.3.3 Cost Completion

The earnings for each activity started. Payment shall be based on earnings for each in-progress or completed activity. Payment for individual activities shall not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

#### 3.6.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, [lag durations,] and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

#### 3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities are those delays beyond the Contractors control such as strikes and unusual weather. Also included are delays encountered due to submittals, Government Activities, deliveries or work stoppage which makes re-planning the work necessary, and when the schedule does not represent the actual prosecution and progress of the work.

### 3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, he shall furnish such justification, project schedule data and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

#### 3.7.1 Justification of Delay

The project schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved with this request.

The Contracting Officer's determination as to the number of allowable days of contract extension, shall be based upon the project schedule updates in effect for the time period in question and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, shall not be a cause for a time extension to the contract completion date.

#### 3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under two weeks based upon the most recent schedule update at the time of the Notice to Proceed or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.
- d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

#### 3.7.3 Additional Submission Requirements

For any request for time extension for over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

### 3.8 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until the Contractor submits revisions, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, then the Contractor shall

advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor will continue to update their schedule with the Contracting Officer's revisions until a mutual agreement in the revisions may be made. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

### 3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

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(((ADD pages A1 through A14 "STANDARD DATA EXCHANGE FORMAT" from ER 1-1-11))))

## SECTION 01356

## STORM WATER POLLUTION PREVENTION MEASURES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 4439	(1995) Standard Terminology for Geotextiles
ASTM D 4491	(1992) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(1995) Identification, Storage, and Handling of Geotextiles

## 1.2 GENERAL

The Contractor shall implement the storm water pollution prevention measures specified in this section in a manner which will meet the requirements of Section 01354 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit attached to that Section, the Burlington County Conservation District Soil Erosion and Sediment Control Permit, and other permits listed in Section 01354.

## 1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Mill Certificate or Affidavit; FIO.

## 1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

## 1.4.1 Stabilization Practices

The stabilization practices to be implemented shall include temporary

seeding, mulching, geotextiles, erosion control mats, protection of trees, etc. On his daily CQC Report, the Contractor shall record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

#### 1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

#### 1.4.1.2 No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the fourteenth day after construction activity temporarily ceased.

#### 1.4.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices. Location and details of installation and construction are shown on the drawings.

##### 1.4.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fences shall be installed in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Contracting Officer.

##### 1.4.2.2 Straw Bales

The Contractor shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in a area between a ridge and drain, bales shall be placed as work progresses, bales shall be removed/replaced/relocated as needed for work to progress in the drainage area). Areas where straw bales are to be used are shown on the drawings. Final removal of straw bale barriers shall be upon approval by the Contracting Officer. Rows of bales of straw shall be provided as follows:

- a. Along the downhill perimeter edge of all areas disturbed.
- b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.

c. Along the toe of all cut slopes and fill slopes of the construction areas.

1.4.2.3 General Erosion Control

The Contractor shall install rock check dams, sandbag dams, desilting devices, and other erosion control measures as shown and detailed on the drawings and as detailed in the Erosion and Sediment Control Plan. The contractor may use similar or alternate devices if approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (%)		30 % max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

#### 2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

#### 2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, or rice, furnished in air dry condition. The bales shall have a standard cross section of 14 inches by 18 inches. All bales shall be either wire-bound or string-tied. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet.

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 24 inches above the ground surface. Filter fabric shall be from in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 6 inches wide and 6 inches deep on the upslope side of the location of the silt fence. The 6-inch by 6-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

#### 3.2 INSTALLATION OF STRAW BALES

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

#### 3.3 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

##### 3.3.1 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade.

### 3.3.2 Straw Bale Maintenance

Straw bale barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales. Necessary repairs to barriers or replacement of bales shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier.

Bale rows used to retain sediment shall be turned uphill at each end of each row. When a straw bale barrier is no longer required, it shall be removed. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 02921 SEEDING.

## 3.4 INSPECTIONS

### 3.4.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

### 3.4.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

### 3.4.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

## SECTION 01410

## ENVIRONMENT PROTECTION

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS.

SD-08 Statements

Environmental Protection Program; GA.

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall submit in writing his detailed proposal for implementing requirements for environmental pollution control specified herein.

Preconstruction Survey; FIO.

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey, after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access routes(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.

Waste Disposal Scheme; FIO.

As part of his proposed implementation under Paragraph 3.2, and prior to onsite construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is dumped in unauthorized area, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 GENERAL

The Contractor shall perform all work in such manner as to minimize the pollution of air, water, or land, and shall, within reasonable limits,

control noise and the disposal of solid waste materials, as well as other pollutants.

### 3.2 IMPLEMENTATION

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall meet the representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.

### 3.3 PROTECTION OF LAND AREAS

Except for any work on storage areas and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURE, UTILITIES AND IMPROVEMENTS, be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSE: OPERATIONS AND STORAGE AREAS, storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contractor Officer.

### 3.4 PROTECTION OF TREES AND SHRUBS

CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES AND IMPROVEMENTS, is hereby supplemented as follows: The Contractor shall not deface, injure or destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage.

#### 3.4.1 Tree Protective Structures

Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, plans, or poles around them.

#### 3.4.2 Restoration of Damaged Trees

Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on trees not designated on the plans to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor so as to be beyond saving in the opinion of the Contracting Officer, shall be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.

### 3.5 PROTECTION OF WATER RESOURCES

The Contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids, or harmful materials, both on and off the Government

premises, and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides from entering public waters. Water used in onsite material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result therefrom.

3.6 NOT USED

3.7 NOT USED

### 3.8 DUST CONTROL

The Contractor shall maintain all excavations, stockpiles, access roads, waste areas, and all other work free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

### 3.9 EROSION CONTROL

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations, should be held to a minimum.

3.10 NOT USED

### 3.11 CORRECTIVE ACTION

The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

### 3.12 POST-CONSTRUCTION CLEANUP OR OBLITERATION

In accordance with CONTRACT CLAUSE: CLEANING UP, the Contractor shall, unless other wise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed areas shall be graded and filled and the entire area seeded.

3.13 PAYMENT

No separate payment or direct payment will be made for the cost of the work covered under this section, and such work will be considered as a subsidiary obligation of the Contractor.

-- End of Section --

## SECTION 01450

## TESTING FOR MECHANICAL AND ELECTRICAL SYSTEMS

## 1. Applicability.

This section applies to all mechanical and electrical systems and all systems using electromagnetically driven equipment, pneumatic or electronic systems; high and low voltage electrical distribution systems (except branch panels) and to any system which incorporates this section into other parts of the specification by reference. For purposes of this section a "system" is an entity comprised of a series of closely related interdependent components and which is capable of independent performance of a useful function. System components shall include all software and programming as applicable for the system. Some typical examples include:

- a. Independently functioning HVAC Systems.
- b. Fire Alarm Systems.
- c. Public Address Systems.
- d. Sprinkler Systems including alarms.
- e. Telephone Systems including line protectors, splices cables, switching equipment, outlets and instruments.
- f. Intrusion Detection System.
- g. High Voltage Equipment including cable, splices, switchgear, relays, circuit breakers, fuses, transformers, instrumentation, etc.
- h. Low Voltage Switchboard including incoming and outgoing feeders, circuit protection and all accessories.

## 2. Test Plan.

a. Not later than sixty days after Notice to Proceed, in accordance with Section "Submittals" and other paragraphs of the technical provisions, the Contractor shall submit a list for approval consisting of all systems for which test plans are required. This list will be reviewed by the Government and any systems found to be missing will be required to be added by the Contractor, and appropriate test plans submitted. No work will be permitted on any of the above systems until this list is submitted.

b. The Contractor shall develop test plans and schedule operational testing for the systems in the approved list. The testing shall be in accordance with the requirements in the appropriate technical provisions and shall include as a minimum the requirements below. All testing required by applicable codes, standards, utility companies, manufacturers, suppliers, etc. shall be incorporated into the Contractor's test plans. Test plans shall list all equipment required to perform the tests, and any Government support required. All fire protection system acceptance tests must be witnessed by the Fort Dix Fire Prevention Bureau. It shall be in sufficient detail to permit a step-by step approach to the test and to demonstrate that the systems operate as intended by the contract documents. It shall describe as a minimum:

1. What system is being tested including a listing of all components to be tested.

2. What individual or organization will perform testing, who will certify the tests, and qualifications of test personnel.

3. A step by step narrative of the testing procedure to be used to demonstrate contract compliance including all governing standards, such as "sequence of controls", "ASTM Standard XXX"; or IEEE Standard XXX", etc.

4. What testing equipment will be utilized.

5. What operator interaction is required.

6. What results are to be expected.

7. Seasonal limitations, if any, including date(s) of proposed testing.

8. A complete schematic diagram (electrical, pneumatic) showing all components, and block diagram.

9. A checklist shall be developed to be used during the operational test.

c. Test plans shall be submitted for approval for all systems contained on the list submitted per para. 2a above. It is also desirable to submit all test plans as soon as possible so that the progress of the project and corresponding payments will proceed on schedule.

3. Testing Process. Outlined below are a number of events relating to the status of the test plan and testing. The corresponding percentages indicate the maximum percentage of the value of the system which will be permitted to be installed after the successful completion of the corresponding event indicated, for all systems to which this section applies. Events must be completed sequentially. Any work performed in excess of the permitted percentages will be at the Contractor's own risk and will not be paid until the event corresponding to the percentage of system value permitted to be installed is successfully completed:

EVENT	MAX. % of SYSTEM VALUE PERMITTED TO BE INSTALLED
1. Contractor has submitted list of systems that require test plans to be approved, and system work is ongoing but no test plan submitted.	50
2. Test Plan Submitted	65
3. *Test Plan Approved	80
4. Successful completion of tests including submission of required documents, reports (i.e. balancing reports for all HVAC Systems), Operation and Maintenance Manuals spare parts, and spare parts data.	**100

\* The Government will process the submittal in accordance with the time frames indicated in the specification section "Submittals". If the test plan is disapproved the Government has an additional 30 days to review the resubmittal from the date it receives the resubmittal.

\*\*If a system involves both heating and cooling modes and one mode has been successfully tested this percentage shall be reduced to 90% until the testing is completed.

b. The Contractor may proceed with events as indicated in the above table for each system separately.

4. Operational tests including performance tests shall be conducted for an entire system, not component parts only. Tests may be conducted only after an entire system has been completely installed. Contractor shall provide a minimum of 14 days notice to the Contracting Officer of scheduled tests. This notice must include the Contractor's assurance that all installed work previously identified to the Contractor as being unacceptable along with all remaining work associated with the respective system will be complete and acceptable by the date scheduled for the operational test. Failure of the Contractor to have all contract work acceptably complete for this test will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection costs.

5. For each system the Contractor shall obtain the services of an experienced professional who shall certify that the operational test was conducted in accordance with the approved test plan and the results of this test meet all the contract requirements. These individuals must have a minimum of eight years experience in the testing of the particular system being tested and shall also meet qualifications (if any) set forth in other technical sections of the contract specifications.

6. When considering the value of a system for payment purposes the following components shall be counted as part of a "system": All electro-magnetically driven equipment; pneumatic or electric control system; gauges, dampers, valves, actuators, controllers, pipes, test sensing elements, logic/processors, CPU's, ducts, insulation, wiring, conduit, switchgear, and all other mechanical or electrical components, devices or equipment which are essential to the proper function of the system such as pumps, motors, air-handling units, chillers, cooling towers, etc. Software programs and any refrigerants are also considered "parts" of a system.

7. The requirements contained in this section supplement other testing requirements contained in the contract documents. If a conflict exists between the requirements of this section and other parts of the contract documents, the requirements of this section shall take precedence.

## SECTION 01451

### CONTRACTOR QUALITY CONTROL

(NYD EDITION 3/98)

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740 (1996) Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1995b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

##### 1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and off site, and shall be keyed to the proposed construction sequence. For purposes of this section the term "construction" shall include all activities relating to the erection of buildings, roads, infrastructure, flood control structures, or activities relating to dredging and disposal, demolition, hazardous and toxic waste removal, etc., as indicated in the contract documents. Other sections of the contract documents may also require separate, specially qualified individuals in such areas as chemical data acquisition, sampling and analysis, medical monitoring, industrial hygiene, safety officer, etc. The CQC organization will coordinate the activities of these individuals. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

##### 3.2 QUALITY CONTROL PLAN

###### 3.2.1 General

The Contractor shall furnish for review by the Government, not later than 90 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause entitled "Inspection of Construction." The plan shall identify personnel, procedures,

control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 90 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

### 3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and off site, including work by subcontractors, fabricator, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Clear indication that CQC System Manager will have no duties other than Quality Control.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters will also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off site fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.) The Contractor shall incorporate all tests required by the contract (including systems commissioning and operating tests) to derive the above list of testing information which shall be presented in matrix form as part of the CQC Plan. This matrix shall be suitable for use by the Contractor and the Government as a checklist to control testing to be done on the contract. Coordinate any additional test submission or plan requirements for Mechanical and Electrical Systems with appropriate specialized specification section if applicable.

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation. Provide matrix of Preparatory and Initial Inspections including specification reference paragraph, the name of the Definable Feature of Work, and spaces for date performed, results, and names of attendees.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section. This list will cover all features of work on the project, and will be agreed upon during the coordination meeting.

j. A brief explanation of the duties of the CQC organization with respect

To safety. Note that separate Accident Prevention Plan and Hazards Analysis is required for submission and acceptance.

- k. Contractor's plan for training all CQC personnel in the CQC System.

### 3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

### 3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

## 3.3 COORDINATION MEETING

After the Pre-construction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 calendar days prior to the Coordination Meeting. The initial plan submitted must be found acceptable by the Government before the Coordination Meeting can be held. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and off site work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

## 3.4 QUALITY CONTROL ORGANIZATION

### 3.4.1 General

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure contract compliance. The number of CQC personnel shall be increased as required during times of high construction workload. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Contracting Officer.

### 3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, or shall hold a state Professional Engineer's license, with a minimum of 2 years construction experience on construction similar to this contract, one year of which as a Quality Control Representative. The CQC Manager may also be a construction person with a minimum of 4 years in related work, one year of which as a QC Representative. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager. The CQC System Manager shall be assigned no duties other than Quality Control.

### 3.4.3 Organizational Expertise

The CQC organization, which includes the CQC System Manager and additional qualified personnel, must as a minimum possess general corporate technical knowledge of all aspects of the project, and must successfully execute the CQC System on all aspects of the project. Individuals possessing experience in specialized areas shall be added to the organization as required during periods when such specialty areas are being executed. Examples of such specialized areas would include HVAC, electrical distribution and substations, roofing, tele-communication systems, fire protection and alarm systems, computer installations, specialized welding, specialized finishes, precast concrete installation, modular housing, specialized geotech work, dredging, sand placement and surveying, chemical data acquisition, hazardous material removal and disposal, medical monitoring, etc., depending on the nature of the particular project. The Contractor must demonstrate that such additional qualified personnel have received sufficient training and indoctrination into the CQC system, and that these personnel properly execute the requirements of the CQC System within their areas of expertise.

#### 3.4.4 Additional Requirement

In addition to the above experience and education requirements the CQC System Manager shall have completed within the last five years the course entitled "Construction Quality Management for Contractors". This course is given at a cost of \$25 by Government personnel and is of two- day duration. The Government will provide one instruction manual for the course.

#### 3.4.5 Organizational Changes

The Contractor shall maintain the CQC Organization at full strength at all times. When it is necessary to make changes to the organization, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

### 3.5 SUBMITTALS

Submittals shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements and are submitted in accordance with the date on the submittal register. CQC personnel shall also make physical checks of materials and equipment before installation to insure compliance with approved shop drawings.

### 3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

#### 3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the worksite, and shall include:

- a. A review of each paragraph of applicable specifications.
- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met per EM 385-1-1, "Safety and Health Requirements Manual".

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase meeting. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall clearly indicate its intent and plan for communication of the results of the preparatory phase to applicable workers, to include materials, construction methods, workmanship standards, safety considerations and procedures, and preparatory phase meeting minutes.

### 3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work (DFW) when the accomplishment of a representative sample of the work is impending.

The following shall be accomplished:

a. A check of the portion of work done to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase meeting. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), the foreman responsible for the definable feature and the work crew(s) for the appropriate DFW. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location (i.e. CQC Report number) of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

### 3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which

may be affected by the deficient work. The Contractor shall not build upon or conceal non-conforming work.

#### 3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable feature of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

#### 3.6.5 Definable Feature of Work: Definition and Discussion

A Definable Feature of Work (DFW) is a portion of work consisting of materials, equipment, supplies and procedures which are closely related to each other, have the same control and will be accomplished by the same work crew to completion. A DFW must be sufficiently small so that control of the work (i.e. communication of requirements to workers, inspection of materials and workmanship and correction of deficiencies) will be easily accomplished. Some examples are:

- \* Rough-in of electrical boxes and wiring methods
- \* Lighting fixtures, receptacles, and accessories
- \* Panelboards, circuit breakers and motors.
- \* Water supply piping, fittings and supports
- \* DWV piping, fittings and supports for plumbing
- \* Concrete reinforcement and formwork
- \* Concrete mixing, placement, curing and finishing
- \* Testing Procedure for contaminated soil, materials and storage tank contents
- \* Storage Tank disassembly and removal
- \* Setting up of decontamination area, exclusion zones and standard safety procedures for asbestos removal
- \* Asbestos removal and disposal procedures
- \* Chemical Data Acquisition
- \* Preparation, removal and disposal of contaminated material
- \* Dredging and placement.

### 3.7 TESTS

#### 3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a laboratory which has been assurance inspected by the Corps of Engineers within the last two years. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.

- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, will be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an off site or commercial test facility will be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.7.2 Testing Laboratories

#### 3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment and calibration in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, aggregate and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329. The Government will perform an assurance inspection of the laboratory which the contractor proposes to perform tests on soils, concrete, asphalt,

#### 3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$1500 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

### 3.7.3 On-Site Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

### 3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, as designated by the Government Representative. Coordination for each specific test, exact delivery location and dates will be made through the Area Office.

## 3.8 COMPLETION INSPECTION

### 3.8.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the Government that the facility is ready for the Government's "Pre-final" inspection.

### 3.8.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is ready to be occupied. A Government "Pre-final Punch List" will be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected and so notify the Government so that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

### 3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person and the contracting Officer's representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final Inspection. Notice will be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being acceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause entitled "Inspection of Construction".

## 3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals reviewed, with contract reference, by whom, and action taken.
- g. Off-site surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. "N/A" shall be entered

into any field for which no entry is intended. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 16 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. All documentation is expected to be literate, legible and complete.

### 3.10 SAMPLE FORMS

(Note: If the Resident Management System (RMS) is required to be used by the contractor for the QC System as indicated elsewhere in this contract, Contractor will generate all reports in the RMS System, and attached forms will serve as guidance only. Otherwise forms contained herein will be used by the by CQC Staff for CQC System reporting ).

a. The 2-page form at the end of the section will be used for the basic CQC Report. CQC personnel shall attach continuation sheets as required for any entries which cannot fit on the basic form. Preparatory and Initial Inspections, when performed, shall be indicated on the basic CQC report and minutes for each inspection shall be attached. Minutes will consist of a list of specific requirements for materials, procedures or equipment to be employed and shall also include any understandings reached or items of special importance discussed.

b. In addition, outstanding deficiencies shall be listed on the form "List of Outstanding Deficiencies" at the end of this section and shall be attached to each CQC report. As deficiencies are corrected, they are to be acknowledged on the basic CQC report and shall be deleted from the list.

c. Form at the end of this section entitled "CQC Test Report List" shall be used by the Contractor to track testing to be done as the project progresses, and also to summarize the Contractor's Quality Control testing to be reported on the CQC Plan.

d. Form "Record of Preparatory and Initial Inspections" at the end of this section shall be used by the Contractor to track Preparatory and Initial inspections as the project progresses and also to summarize these required inspections as part of the CQC Plan.

e. Additional reporting forms pertaining to specialized activities may be included herein or elsewhere in the contract, and shall be used for reporting as indicated.

### 3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor. Deficiencies cited and verbal instructions given to the Contractor by the Government Representative shall be entered into that day's CQC Report.

(FORMS FOLLOW)

-- End of Section --



## SECTION 01500

## TEMPORARY CONSTRUCTION FACILITIES

## 1.1 GENERAL REQUIREMENTS

## 1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

## 1.1.2 Not

## 1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

## 1.2 NOT USED.

## 1.3 NOT USED

## 1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

## 1.4.1 Not Used

## 1.4.2 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

## 1.5 NOT USED

1.6 NOT USED.

1.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 1.1 m 42 inches high, supported and tightly secured to steel posts located on maximum 3 m 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.9 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.10 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

PART 2 NOT APPLICABLE

PART 3 NOT APPLICABLE

---End of Section---

## SECTION 01740

## CONTRACTOR WARRANTY MANAGEMENT

## 1. References:

- a. Clause "Warranty of Construction", (FAR 52.246-0021)
- b. Clause "Inspection of Construction" (FAR 52.246-12)
- c. Special Requirement paragraph entitled "Record Drawings"
- d. Specification Section entitled "Contractor Quality Control"

2. General: In order to insure that the Government systematically receives all warranties of construction, equipment and systems to which it is entitled, the contractor shall execute all actions as required by above references and as contained herein.

3. Post-Completion Inspections: For purposes of management of construction warranties, the Government conducts four and nine month warranty inspections with using agencies. The Contractor is encouraged to attend these inspections in order to better manage any warranty items for which it may be responsible.

4. Tagging of Extended Warranty Items: The Contractor shall install tags to identify items protected by extended warranty, i.e. longer than the one year general warranty of construction. The tags shall be minimum 3 inches by 5 inches in size, machine-printed in minimum 14-point type, and shall be weatherproof. Tags shall be attached to equipment if accessible or to accessible control panel, etc. As a minimum, tags shall indicate the following information:

"Extended Warranty Item:"

Name of Item  
Name of System with which associated, number designation within system, or other identifier  
Model Number  
Serial Number  
Start and end Dates of Warranty  
Contract number  
Contract Name  
Contractor Name  
Point of Contact name, organization and telephone number.

5. Posting of Instructions: In addition to any posting of operating procedures as may be required elsewhere in this contract, any equipment or system for which proper operation or maintenance is critical in order to preserve warranties, prevent damage, or for reasons of safety shall have proper operating procedures posted near the equipment or near the operating point. Instructions shall be protected by 1/16 inch thick plastic sheet. As a minimum such equipment or system shall include:

Electrical Substations  
Transformers

## Electrical Generators

Major HVAC System components including chillers, air-handlers, fans, etc.

HVAC Control Panel

Boilers

Air Compressors

6. Warranty Meeting. At least 14 days prior to the 80% completion point of this contract (or deliverable phase thereof ), the contractor will notify the Government representative for the purpose of scheduling a meeting to clarify understandings of responsibilities with respect to warranties to which the Government is entitled. The Government and contractor shall attend the warranty meeting, as well as any subcontractors, or suppliers involved in the warranty process. The Warranty Plan (below) shall have already been submitted and approved by the Government before the warranty meeting can take place, and shall be the basis of the meeting's agenda.

7. Warranty Plan. At least 30 days before the planned warranty meeting, the contractor shall submit a warranty plan for Government approval per section "Submittals". The Warranty Plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. As a minimum the plan shall indicate:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the contractor's, subcontractors or suppliers involved.

b. Listing and status of O&M manuals and As-built drawings, and expected delivery dates.

c. Listing and status of all training to be provided to Government personnel, whether specified by contract or required by manufacturers.

d. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

e. A list for each warranted equipment, item, feature of construction or system indicating:

Name of item

Model and serial numbers.

Location where installed

Names of manufacturers or, suppliers and phone numbers.

Names addresses and telephone numbers of sources of spare parts

Warranties and terms of warranty. This shall include one-year overall warranty of construction as required by ref. 1.a. Clearly indicate which items have extended warranties.

Cross-reference to warranty certificates as applicable

Starting point and duration of warranty period.

Summary of maintenance procedures required to continue the warranty in force.

Cross-reference to specific pertinent Operation and Maintenance manuals  
Organization, names and phone numbers of persons to call for warranty service  
Typical response time and repair time expected for various warranted equipment

f. The contractor's plans for attendance at the Four and Nine month post-construction warranty inspections conducted by the Government.

g. Procedure and status of tagging of all equipment covered by extended warranties.

h. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons

-- End of Section --

SECTION 02230  
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-18 Records

Materials Other Than Salable Timber; FIO.

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the final surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and

compacted to make the surface conform with the original adjacent surface of the ground.

### 3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

### 3.4 DISPOSAL OF MATERIALS

#### 3.4.1 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths, and stockpiled at locations as directed. The disposal of the stockpiled timber will be by the Government.

#### 3.4.1 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

## SECTION 02300

## EARTHWORK

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1140	(1992) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT)

NJDOT	Standard Specifications for Road and Bridge Construction (Current Edition)
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## 1.2 NOT USED

## 1.3 NOT USED

## 1.4 DEFINITIONS

## 1.4.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SM, SW-SM, and SP-SM. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements and railroads which shall be comprised of stones less than 3 inches in any dimension.

#### 1.4.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

#### 1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

#### 1.4.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density.

#### 1.4.5 NOT USED

#### 1.4.6 Topsoil

Material suitable for topsoils obtained from offsite areas where needed and excavations with a high organic content and meeting New Jersey DOT (NJDOT) Specifications Section 909.10.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-08 Statements

Earthwork; GA.

Procedure and location for disposal of unused satisfactory material.  
Proposed source of borrow material.

#### SD-09 Reports

Testing; GA.

Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests.

#### SD-13 Certificates

Testing; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

## SD-18 Records

Earthwork; FIO.

Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

## 1.6 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings. The subsoil investigation report may be examined at the offices of the Contracting Officer. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

## 1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

## 1.8 BLASTING

Blasting will not be permitted.

## 1.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

## 3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 4 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

## 3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with

the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas.

During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

### 3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

### 3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

### 3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown or from other approved sources, either private or within the limits of the project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

### 3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise

disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

### 3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

### 3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02720 STORM-DRAINAGE SYSTEM; and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

#### 3.7.1 General Requirements

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 8 inches; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

#### 3.7.2 Frozen Material

Embankment shall not be placed on a foundation which contains frozen material, or which has been subjected to freeze-thaw action. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades (whether in an excavation or on an embankment) and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, winter shutdowns, or earthwork operations, shall be removed to a depth that is acceptable to the Contracting Officer and replaced with new material. Alternatively, the material will be thawed, dried, reworked, and recompacted to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill shall cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for his determination. Embankment material shall

not contain frozen clumps of soil, snow, or ice.

### 3.8 EMBANKMENTS

#### 3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.9 SUBGRADE PREPARATION

#### 3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1 inch when tested with a 10 foot straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finish subgrade shall not vary more than 0.05 foot from the established grade and cross section.

#### 3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, each layer of the embankment shall be compacted to at least 90 percent of laboratory maximum density.

##### 3.9.2.1 NOT USED

##### 3.9.2.2 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density. When more than one soil classification is present in the subgrade, the top 12 inches of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

##### 3.9.2.3 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 92 percentage laboratory maximum density for the full depth of the shoulder.

### 3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

### 3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

### 3.12 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 4 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

### 3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. The first inspection will be at the expense of the Government. Cost incurred for any subsequent inspections required because of failure of the first inspection will be charged to the Contractor. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922 based upon the recommendation of the testing laboratory. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state

that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

#### 3.13.1 Fill and Backfill Material Gradation

One test per 750 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140.

#### 3.13.2 In-Place Densities

- a. One test per 750 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. One test per 250 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

#### 3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

- a. One check test per lift for each 3000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. One check test per lift for each 1000 square feet, of fill or backfill areas compacted by hand-operated machines.

#### 3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

#### 3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 750 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

#### 3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

#### 3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be

placed on a muddy, spongy, or frozen subgrade.

-- End of Section --

## SECTION 02315

## EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## 1.2 DEGREE OF COMPACTION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, abbreviated as percent laboratory maximum density.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Testing; GA.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SM, SW-SM, and SP-SM.

#### 2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 2 inches. The Contracting Officer shall be notified of any contaminated materials.

#### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic.

#### 2.1.4 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 25 when tested in accordance with ASTM D 4318.

#### 2.1.5 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material shall be a uniformly graded washed sand with a maximum particle size of 1/2 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

#### 2.1.6 Impervious Fill

Impervious fill shall be satisfactory material classified in ASTM D 2487 as CL or CH, with liquid limit greater than 30 and plasticity index greater than 15.

### 2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and no more than 2 percent by weight shall pass the No. 4 size sieve.

## PART 3 EXECUTION

### 3.1 CLEARING AND GRUBBING

The areas within lines 5 feet outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be

completely removed and the resulting depressions shall be filled with satisfactory material, placed and compacted in accordance with paragraph FILLING AND BACKFILLING. Materials removed shall be disposed of outside the limits of Government-controlled property at the Contractor's responsibility.

### 3.2 TOPSOIL

Topsoil shall be stripped to a depth of 4 inches below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

### 3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified, and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the building line of each building and structure, excavation for all work incidental thereof. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms.

Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material; and payment will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced, at no additional cost to the Government, with satisfactory materials to the indicated excavation grade; except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

### 3.4 DRAINAGE AND DEWATERING

#### 3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

#### 3.4.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet below the working level.

### 3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as

necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

### 3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

### 3.7 BLASTING

Blasting will not be permitted.

### 3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

### 3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained as specified in Section 02300 EARTHWORK.

### 3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Section 02300 EARTHWORK.

### 3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond.

### 3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily

facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.13 FILLING AND BACKFILLING

3.13.1 General Filling and Backfilling

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
	-----	-----
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
Nonfrost susceptible materials		95
<u>Subgrade</u>		
Under building slabs, steps, and paved areas, top 12 inches	90	95
Under sidewalks, top 6 inches	85	90

Approved compacted subgrades that are disturbed by the Contractor's

operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompaction over underground utilities and heating lines shall be by hand tamping.

### 3.13.2 Magazine Backfilling

After the concrete arches have been waterproofed and the concrete walls have been dampproofed as specified, arch cover fill materials shall be carefully placed to avoid damage to the waterproofing and dampproofing, and the sequence and method of placing and compacting the fill shall be such as not to distort the shape, alignment, and dimensions of the arches as shown.

Filling over a line of multiple arches shall not be started until all arches in the line have been waterproofed and dampproofed. Fill shall be brought up evenly and simultaneously on both sides of the arch. Filling operations shall commence at the front and rear of a structure and continue uniformly to the center. At no time shall heavy equipment be run over the fill directly above the arches. Distortion or damage to the arches or other work, as determined by the contracting Officer, shall be repaired or replaced by the Contractor at no additional cost to the Government.

### 3.14 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

#### 3.14.1 In-Place Densities

In-place density and moisture content test results shall be included with the Contractor's daily construction quality control reports.

##### 3.14.1.1 In-Place Density of Subgrades

One test per 500 square foot or fraction thereof.

##### 3.14.1.2 In-Place Density of Fills and Backfills

One test per 250 square foot or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 6 feet in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 250 square feet, or one test for each 50 linear foot of long narrow fills 100 feet or more in length. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows: One check per lift for each 250 linear feet of long narrow fills, and a minimum of 3 checks per lift for other fill and backfill areas.

##### 3.14.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

### 3.14.3 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material, including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

### 3.15 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

### 3.16 GRADING

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.17 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

### 3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

## SECTION 02316

## EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

## 1.2 NOT USED

## 1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Density Tests; GA. Testing of Backfill Materials; GA.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

## PART 2 PRODUCTS

## 2.1 MATERIALS

### 2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SM, SW-SM, and SP-SM.

### 2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

### 2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements shall not be considered as rock.

### 2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

### 2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

### 2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be 1 1/2 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

### 2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 2 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 1 inches in any dimension or as recommended by the pipe manufacturer, whichever is

smaller.

## 2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

## PART 3 EXECUTION

### 3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

#### 3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made no steeper than 2:1. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls more than 6 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

#### 3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

#### 3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

#### 3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

#### 3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

#### 3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

#### 3.1.2 Stockpiles

Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

#### 3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be

placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

### 3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

#### 3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

#### 3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

#### 3.2.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

#### 3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

### 3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 NOT USED

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 4 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 50 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The

calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

#### 3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

## SECTION 02510

## WATER DISTRIBUTION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM C 76	(1995a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM D 1599	(1988; R 1995) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996a) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1996) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D 2997 (1995) Centrifugally Cast "Fiberglass"  
(Glass-Fiber-Reinforced-Thermosetting-Resin)  
Pipe

ASTM D 3139 (1996a) Joints for Plastic Pressure Pipes  
Using Flexible Elastomeric Seals

ASTM D 3839 (1994a) Underground Installation of  
"Fiberglass" (Glass-Fiber-Reinforced  
Thermosetting Resin) Pipe

ASTM F 477 (1995) Elastomeric Seals (Gaskets) for  
Joining Plastic Pipe

ASTM F 1483 (1993) Oriented Poly(Vinyl Chloride),  
PVC0, Pressure Pipe

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1 (1983; R 1992) Pipe Threads, General  
Purpose (Inch)

ASME B16.1 (1989) Cast Iron Pipe Flanges and Flanged  
Fittings

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA ANSI/AWWA C104/A21.4 (1995) Cement-Mortar Lining for  
Ductile-Iron Pipe and Fittings for Water

AWWA ANSI/AWWA C105/A21.5 (1993) Polyethylene Encasement for  
Ductile-Iron Pipe Systems

AWWA ANSI/AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron  
Fittings, 3 In. Through 48 In. (75# mm  
through 1200# mm), for Water and Other  
Liquids

AWWA ANSI/AWWA C111/A21.11 (1995) Rubber-Gasket Joints for  
Ductile-Iron Pressure Pipe and Fittings

AWWA ANSI/AWWA C115/A21.15 (1994) Flanged Ductile-Iron Pipe With  
Ductile-Iron or Gray-Iron Threaded Flanges

AWWA ANSI/AWWA C151/A21.51 (1996) Ductile-Iron Pipe, Centrifugally  
Cast, for Water or Other Liquids

AWWA ANSI/AWWA C153/A21.53 (1994; Errata Nov 1996) Ductile-Iron  
Compact Fittings, 3 In. Through 24 In. (76  
mm through 610 mm) and 54 In. through 64  
In. (1,400 mm through 1,600 mm) for Water  
Service Liquids

AWWA C200 (1991) Steel Water Pipe - 6 In. (150 mm)  
and Larger

AWWA C500 (1993; C500a) Metal-Sealed Gate Valves for  
Water Supply Service

AWWA ANSI/AWWA C502 (1994; C502a) Dry-Barrel Fire Hydrants

AWWA C504 (1994) Rubber-Seated Butterfly Valves

AWWA C509 (1994) Resilient-Seated Gate Valves for Water Supply Service

AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C606 (1987) Grooved and Shouldered Joints

AWWA C800 (1989) Underground Service Line Valves and Fittings

AWWA C900 (1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

AWWA C901 (1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service

AWWA C905 (1988) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.

AWWA C950 (1995) Fiberglass Pressure Pipe

AWWA M23 (1980) Manual: PVC Pipe - Design and Installation

## ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA-01 (1988) Recommended Work Practices for A/C Pipe

## DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01 (1997) Thrust Restraint Design for Ductile Iron Pipe

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24 (1995) Installation of Private Fire Service Mains and Their Appurtenances

NFPA 49 (1994) Hazardous Chemicals Data

NFPA 325-1 (1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NFPA 704 (1996) Identification of the Fire Hazards of Materials for Emergency Response

## NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 14 (1996) Plastics Piping Components and Related Materials

NSF ANSI/NSF 61 (1997a) Drinking Water System Components -

## Health Effects (Sections 1-9)

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

## 1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

## 1.2.1 Service Lines

Piping for water service lines less than 3 inches in diameter shall be polyvinyl chloride (PVC) plastic, Oriented PVC plastic, or polyethylene, unless otherwise shown or specified.

## 1.2.2 Distribution Lines 80 mm (3 Inches) or Larger

Piping for water distribution lines 3 inches or larger shall be ductile iron, polyvinyl chloride (PVC) through 36 inch nominal diameter plastic, Oriented PVC plastic filament-wound or centrifugally cast reinforced thermosetting resin or reinforced plastic mortar pressure pipe, unless otherwise shown or specified.

## 1.2.3 NOT USED

## 1.2.4 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5 foot line.

## 1.2.5 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF ANSI/NSF 61.

## 1.2.6 Plastic Piping System

Plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF ANSI/NSF 14 and be legibly marked with their symbol.

## 1.2.7 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

## 1.3 NOT USED

## 1.4 NOT USED

## 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

SD-08 Statements

Waste Water Disposal Method; GA.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacteriological Disinfection; GA.

Test results from commercial laboratory verifying disinfection.

SD-13 Certificates

Manufacturer's Representative; FIO.

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified in all phases of PE, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers, prior to commencing installation.

Installation; FIO.

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

1.6 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark

place.

1.6.1 NOT USED

1.6.2 Polyethylene (PE) Pipe Fittings and Accessories

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

1.6.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 NOT USED

2.1.2 Plastic Pipe

2.1.2.1 PE Plastic Pipe

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.2.2 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4 inch Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure psi	Minimum Hydrostatic Pressure psi
26	100	133
21	120	160
17	150	200
13.5	200	266

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic

test pressure.

- b. Pipe 4 through 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.
- c. Pipe 14 through 36 inch Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

#### 2.1.2.3 Oriented Polyvinyl Chloride (PVCO) Plastic Pipe

Pipe, couplings, and fittings shall be manufactured of material conforming to ASTM D 1784, Class 1245B. Pipe shall conform to AWWA C900, Class 150, and to ASTM F 1483 and shall have an outside diameter equal to cast iron outside diameter.

#### 2.1.3 Reinforced Plastic Mortar Pressure (RPMP) Pipe

AWWA C950.

#### 2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

##### 2.1.4.1 RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

##### 2.1.4.2 RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

#### 2.1.5 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA ANSI/AWWA C151/A21.51, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA ANSI/AWWA C104/A21.4. Linings shall be standard. When installed underground, pipe shall be encased with 4 mil thick polyethylene in accordance with AWWA ANSI/AWWA C105/A21.5. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA ANSI/AWWA C115/A21.15.

## 2.2 FITTINGS AND SPECIALS

### 2.2.1 NOT USED

### 2.2.2 PVC Pipe System

- a. For pipe less than 4 inch diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings; fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA ANSI/AWWA C110/A21.10 or AWWA ANSI/AWWA C111/A21.11. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4.

- b. For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA ANSI/AWWA C110/A21.10, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA ANSI/AWWA C153/A21.53.

#### 2.2.3 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA ANSI/AWWA C104/A21.4 and shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11. Fittings shall be suitable for working and testing pressures specified for the pipe.

#### 2.2.4 Ductile-Iron Pipe System

Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA ANSI/AWWA C110/A21.10. Fittings and specials for use with push-on joint pipe shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4. Ductile iron compact fittings shall conform to AWWA ANSI/AWWA C153/A21.53.

### 2.3 JOINTS

#### 2.3.1 NOT USED

#### 2.3.2 Plastic Pipe Jointing

##### 2.3.2.1 PE Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation, and as approved by the Contracting Officer.

##### 2.3.2.2 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

##### 2.3.2.3 PVC0 Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

##### 2.3.3 RPMP Pipe

Joints shall be mechanical or bell and spigot type with elastomeric gasket.

##### 2.3.4 RTRP Pipe

###### 2.3.4.1 RTRP-I, Grade 1 and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

#### 2.3.4.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

#### 2.3.5 Ductile-Iron Pipe Jointing

- a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA ANSI/AWWA C111/A21.11.
- b. Push-on joints shall conform to AWWA ANSI/AWWA C111/A21.11.
- c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA ANSI/AWWA C111/A21.11.

#### 2.3.6 NOT USED

#### 2.3.7 NOT USED

#### 2.3.8 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

- a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.
- b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

#### 2.4 VALVES

##### 2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

- a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

- b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

#### 2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

- a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.
- b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.
- c. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

#### 2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

#### 2.4.4 NOT USED

#### 2.4.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

#### 2.4.6 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post.

#### 2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

## 2.6 NOT USED

## 2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA ANSI/AWWA C502 and UL approved with valve opening at least 5 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade. Hydrants shall have a 6 inch bell connection, two 2-1/2 inch hose connections and one 4-1/2 inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for each outlet, with caps, shall be furnished.

## 2.8 NOT USED

## 2.9 MISCELLANEOUS ITEMS

## 2.9.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

## 2.9.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

## 2.9.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

## 2.9.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

## 2.9.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating

collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

#### 2.9.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

#### 2.9.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

##### 3.1.2 Adjacent Facilities

###### 3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

###### 3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

###### 3.1.2.3 NOT USED

###### 3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

### 3.1.2.5 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be steel, manufactured in accordance with AWWA C200, ASTM A 36/A 36M, or reinforced concrete in accordance with and ASTM C 76, Class V as specified for storm drains in Section 02720 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve.

### 3.1.2.6 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

### 3.1.3 Joint Deflection

#### 3.1.3.1 NOT USED

#### 3.1.3.2 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

#### 3.1.3.3 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

### 3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

#### 3.1.4.1 NOT USED

#### 3.1.4.2 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be

installed in accordance with AWWA M23.

#### 3.1.4.3 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA-01.

#### 3.1.4.4 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

#### 3.1.4.5 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

#### 3.1.5 Jointing

##### 3.1.5.1 NOT USED

##### 3.1.5.2 PE Pipe Requirements

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

##### 3.1.5.3 PVC Plastic Pipe Requirements

- a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.
- b. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

##### 3.1.5.4 RTRP I, RTRP II and RPMP Pipe

- a. RTRP I: Assembly of the pipe shall be done in conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously.

However, the pipe shall not be moved and additional joints shall not be made until the previously laid joints are completely cured.

Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 1,500 psior greater when carried out in accordance with ASTM D 1599. At any ambient temperature, field bonded epoxy-cemented joints shall be cured with a self-regulating, thermostatically temperature controlled, electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating, or until the joint has cooled to ambient temperature.

- b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.
- c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 1/8 inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 100 foot pounds. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

#### 3.1.5.5 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

#### 3.1.5.6 NOT USED

#### 3.1.5.7 NOT USED

#### 3.1.5.8 NOT USED

#### 3.1.5.9 Bonded Joints Requirements

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

#### 3.1.5.10 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance

with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.11 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

- a. Service lines 1-1/2 inches and smaller shall have a service stop.
- b. Service lines 2 inches in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

### 3.1.6.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

### 3.1.7 NOT USED

### 3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

#### 3.1.8.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inches square. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

#### 3.1.8.2 NOT USED

#### 3.1.8.3 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

#### 3.1.8.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

### 3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

### 3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent

movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

#### 3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

#### 3.1.10.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

### 3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

#### 3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the project.

Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

#### 3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at

least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

### 3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

### 3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently if the specified requirements for both tests are strictly followed.
- b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

## 3.3 DISINFECTION

### 3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as specified. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid

state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

### 3.3.2 Lead Residual

Following the bacteriological disinfection and testing, the system shall be flushed with a sufficient velocity of water and sufficient tests performed at each hot and cold water discharge point until no more than 15 ppb lead residuals remain in the system. All tests and samples shall be performed in accordance with state and, if applicable, Federal regulations. Samples for testing are to be collected after a 6 hour continuous period of no flushing, and will be considered first draw samples. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. Lead residual test results shall be submitted to the Contracting Officer. The system will not be accepted until satisfactory bacteriological results and lead residual test results have been obtained. All flushing and testing for lead residuals, including all costs, are the responsibility of the Contractor.

### 3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

## SECTION 02521

## WATER WELLS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 150	(1997) Portland Cement
ASTM D 2239	(1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA A100	(1990) Water Wells
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C206	(1991) Field Welding of Steel Water Pipe

## CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 141	National Primary Drinking Water Regulations
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## 1.2 NOT USED

## 1.3 GENERAL REQUIREMENTS

The well shall be located as shown on the contract drawings. The well shall be of sufficient depth to penetrate a desirable water-bearing stratum and produce a continuous yield of 70 gpm of potable water. Potable is defined as water that is suitable for public consumption, i.e., water free from objectionable amounts of harmful bacteria, chemical, and physical substances as established by 40 CFR 141.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Water Well; GA.

Detail drawings illustrating materials to be used for the well installation shall be provided. Drawings shall show proposed layouts of the casing and screen in relation to the other materials of construction.

#### SD-08 Statements

Work Plan; GA.

Proposed plan for drilling test holes and constructing production wells, before beginning work. The plan shall include, but shall not be limited to, the proposed method of drilling and equipment to be used, details on proposed casing, well screen, grouting material, gravel pack material and method for placing gravel pack where required, and methods and equipment proposed for developing the well and for performing pump tests. Work shall not be performed until the drilling plan has been approved and deviation from the approved drilling plan will not be permitted without approval of the Contracting Officer. Details of specific methods to be employed to control potential contamination or pollution arising from well installation activities, shall also be included.

#### SD-09 Reports

Tests; GA.

Test Reports within 24 hours following the conclusion of each test.

#### SD-18 Records

Permits; FIO.

A copy of all permits, licenses, or other legal requirements necessary for execution of the work shall be obtained prior to commencement of field activities. Before beginning work, the local United States Geological Survey office (USGS) and the New Jersey Department of Environmental Protection (NJDEP), Bureau of Water Allocation shall be notified of the type and location of wells to be constructed, the method of construction, water quality testing, and anticipated schedule for construction of the wells. A copy of all such correspondence shall be furnished.

All equipment required to establish "potable water" in accordance with New Jersey Safe Drinking Water Act shall be contractor provided.

Boring Log; FIO.

An accurate log maintained during the drilling of the test hole. As a minimum, the log shall include depths, elevations, and descriptions of all formations encountered; identification of each stratum according to ASTM D 2487 ; or standard rock nomenclature, as necessary; and depths at which groundwater is encountered. Soil samples shall be taken each 10 feet with a split-spoon sampler. The Contractor shall prepare a graphic boring log to scale showing the required details. Five prints of the boring log drawing shall be submitted. This drawing shall be used for determining the well design, design of the gravel filter, well screen location and screen openings, and New Jersey permit requirements.

### 1.5 ENVIRONMENTAL PROTECTION

The Contractor shall take necessary precautions to prevent contaminated water, or water having undesirable physical or chemical characteristics, from entering the water supply stratum through the well bore or by seepage from the ground surface; and shall prevent contamination of the ground surface or of surface waters resulting from drilling of the test-hole or well.

## 1.6 TEST HOLES AND OBSERVATION WELLS

### 1.6.1 Test Holes

Before starting construction of the well, a test hole of at least 4 inches in diameter shall be drilled at the location of the well into the target water bearing stratum. The test hole shall be used to determine the expected yield from the well, water quality, optimum depth, and to log the strata encountered. A temporary casing shall be used. If used, the temporary casing shall be seated at the top of the stratum being tested. The test hole may be converted to the permanent well. If the test hole is not used for the permanent well, the test hole shall be filled with sand-cement grout placed by tremie or pumped through the drill pipe.

## 1.7 ABANDONMENT OF WELLS

If the Contractor fails to construct a well of the required capacity, or if the well is abandoned because of loss of tools or for any other cause, the Contractor shall fill the abandoned hole with sand-cement grout and remove the casing.

## PART 2 PRODUCTS

### 2.1 CASING

The casing shall be of sufficient size for the specified maximum yield. All casing, screen, and other well material shall be of compatible materials to prevent galvanic reaction between components of the completed well.

#### 2.1.1 Steel Casing and Couplings

Steel casing shall be standard weight galvanized steel pipe, conforming to ASTM A 53, as applicable. Joints shall be either threaded and coupled, or field welded in accordance with AWWA C206.

#### 2.1.2 NOT USED

#### 2.1.3 Inner Casing

The inner casing shall be sized at a minimum of 6 inches, based on the pump required in paragraph PERMANENT PUMP for maximum required yield, and shall be constructed of the same materials as the outer casing and the well screen. The inner casing shall be connected directly to the top of the well screen by an approved method.

### 2.2 WELL SCREENS

Well Screens shall be a minimum of 6 inches nominal diameter, and shall be directly connected to the bottom of the inner casing by an approved method.

The length of the screen shall be sufficient to provide an intake area capable of passing not less than the minimum required yield of the well, at an entrance velocity not exceeding 0.1 fps. The opening size shall be compatible with the material surrounding the screen and shall be submitted for approval as part of the drilling plan. The well screen shall be of sufficient size and design to hold back and support the gravel used in the gravel envelope and in-situ material surrounding the screen. The screen and all accessories required for satisfactory operation shall be essentially standard products of manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable.

#### 2.2.1 Metal Screen

Metal screen shall be of an approved wire-wound type with wire not less than No. 7 AWG and the supporting bars not less than 1/4 inch thickness.

Both wire and supporting bars shall be type 304 or type 314 stainless steel, conforming to the applicable requirements of AWWA A100. If a pipe core is used, it shall be at least schedule 10 pipe and shall be of the same material as the wire. A wire-wound screen manufactured with supporting bars or core of material different from the wire will not be acceptable. Joints shall be made of threaded couplings of the same material as the screens or by brazing or welding in accordance with AWWA C206.

### 2.3 GRAVEL PACK

Gravel pack shall be a product of a commercial sand and gravel manufacturer, shall be properly sized and graded for the surrounding soil and water encountered, and shall be composed of round, hard, waterworn siliceous gravel, free of flat or elongated pieces, organic matter, or other foreign matter. The gravel shall be of a size which will allow the maximum flow of water into the well and prevent the infiltration of sand and silt. The gradation of the filter gravel shall be such that the uniformity coefficient is not more than 2.5. The gravel shall be thoroughly sterilized with chlorine or hypochlorite immediately before being placed.

### 2.4 CEMENT GROUT

Cement grout shall consist of portland cement conforming to ASTM C 150, Type I or II, sand and water. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

### 2.5 PERMANENT PUMP

Permanent pump shall be an approved submersible type with a capacity sufficient to deliver 70 gpm at 65 psi, Section 11213 PERMANENT PUMP. The pump shall be connected to the pump controls by a three-wire drop line. Piping for the well drop line shall be polyethylene plastic pipe conforming to ASTM D 2239. The pump shall operate on 208 volts, 60 Hz, 3-phase power, and the motor shall be of sufficient size to operate the pump under the maximum operating conditions without exceeding its rating. Pump shall be equipped with necessary controls to provide for automatic operation of the pump. The pump and motor unit shall be no larger than 6 inches in diameter at any point.

## PART 3 EXECUTION

### 3.1 WELL CONSTRUCTION

The method of drill shall be as approved by the Contracting Officer and shall conform to all state and local standards for water well construction.

The execution of the work shall be by competent workmen and shall be performed under the direct supervision of an experienced well driller, licensed in the State of New Jersey. Casing pipe, well screens, and joint couplings shall be of compatible materials throughout each well. The well shall be a gravel pack well activated in the water-bearing stratum based on test hole data. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be initially drilled from the ground surface to the water bearing strata.

#### 3.1.1 NOT USED

#### 3.1.2 Construction of Inner Casing and Screen

The casing shall not be less than 6 inches in diameter. The borehole shall be of sufficient size to leave a concentric annular space of not less than 2 1/2 inches between the outside of the casing and the walls of the

borehole. The well screen and inner casing shall be lowered into the hole by a method which will allow for control of the rate of fall of the well screen and inner casing at all times. Well screen and inner casing shall not be dropped or allowed to fall uncontrolled into the hole. The inner casing shall extend up to the ground surface. Approved centering devices shall be installed at a spacing of 120 degrees between the casing and the walls of the borehole prior to well construction at intervals not exceeding 50 feet along the length.

### 3.1.3 Construction of Gravel Pack

After the screen and inner casing have been concentrically set in the hole, the approved gravel pack shall be constructed around the screen by filling the entire space between the screen and the wall of the hole in the water bearing stratum with filter gravel. Well screen and casing used for gravel pack wells shall have approved centering devices spaced 120 degrees apart at intervals not exceeding 50 feet along the length of the screen and inner casing. The gravel pack shall be tremied to the screened interval with conductor pipe. Gravel conductor pipe having an inside nominal diameter of not less than 1-1/2 inches shall be lowered to the bottom of the well between the hole and screen. Gravel conductor pipe shall be arranged and connected, at the surface of the ground, to water pumping and graveling equipment so that water and gravel, fed at uniform rates, are discharged as the gravel fills the hole from the bottom up. The gravel and water conductor shall be raised at a rate that will keep the bottom of the pipe between 1 and 3 feet under the gravel level at all times. If the Contractor desires to use methods of placing gravel other than those specified, the details of the method and equipment proposed shall be submitted to the Contracting Officer, before gravel placing is begun; however, dumping filter gravel from the surface of the ground and agitating the well in an effort to settle the filter will not be allowed. The gravel pack shall be installed continuously and without interruption until the gravel has been placed to a maximum of 10 feet above the top of the screen.

### 3.1.4 Placing Packer

After the casing, well screen and gravel pack have been installed, the annular space between the casings and the borehole shall be sealed by use of an approved packer. A cement/bentonite grout shall be used to seal the well. Grout conductor pipe having an inside diameter of not less than 1-1/2 inches shall be lowered to within 5 feet of the gravel pack. The grout conductor shall be raised at a rate that will keep the bottom of the pipe between 1 and 3 feet under the grout level at all times. The cement/bentonite grout shall extend from the top of the gravel pack to within 5 feet of the ground surface.

## 3.2 WELL DEVELOPMENT

The well shall be allowed to set no less than 24 hours after construction then developed in accordance with the drilling plan, by approved methods until the water pumped from the well is substantially free from sand and silt and until the turbidity is less than 5 on the Jackson Turbidity Scale specified in AWWA-01. Developing equipment shall be of an approved type and of sufficient capacity to remove all cutting fluids, sand, rock cuttings, and any other foreign material. The well shall be thoroughly cleaned from top to bottom before beginning the well tests.

## 3.3 TESTS

During construction of the well, when sufficient water is found to indicate that a well of required capacity may be developed, or when directed, a capacity test shall be performed. If the capacity test indicates that the required capacity can be obtained, the tests for quality of water shall be made. If the capacity and quality tests indicate that the required capacity and quality can be obtained, the permanent well, as specified,

shall be completed at that depth. Prior to making quality tests, drilling equipment, tools and pumps contacting well water shall be cleaned with live steam.

### 3.3.1 Capacity Test

The Contractor shall furnish and install an approved temporary test pump, with discharge piping of sufficient size and length to conduct the water being pumped to point of discharge, and equipment necessary for measuring the rate of flow and water level in the well. A continuous 8 hour capacity test shall be run with the pumping rate and drawdown at the pump well recorded every 1/2 minute during the first 5 minutes after starting the pump; then every 5 minutes for an hour; then every 20 minutes for 2 hours. From this point on, readings taken at hourly intervals shall be sufficient.

The test shall begin at the rate of the expected capacity of well and at least that rate maintained throughout the duration of the test. If this capacity cannot be maintained for the test period, the capacity test shall be terminated and the test hole drilled deeper or relocated as directed. The record of the test, in triplicate, shall be delivered to the Contracting Officer, in accordance with NJDEP, Bureau of Water Allocation Well record form. The well record form includes well permit number, well owner, name and address, well location address, well use, date construction, well construction details, pumping test records, permanent pumping equipment, geologic log, and certification by well driller.

### 3.3.2 Test for Plumbness and Alignment

Upon completion of the permanent well, plumbness and alignment shall be tested by lowering into the well, to the total depth of the well, a plumb 40 feet long or a dummy of the same length. The outer diameter of the plumb shall not be more than 1/2 inch smaller than the diameter of that part of the hole being tested. If a dummy is used, it shall consist of a rigid spindle with three rings, each ring being 2 inches wide. The rings shall be cylindrical and shall be spaced one at each end of the dummy and one in the center. The central member of the dummy shall be rigid so that it will maintain the alignment of the axis of the rings. If the plumb or dummy fail to move freely throughout the length of the casing or well screen for the depth of well or should the well vary from the vertical in excess of two-thirds the inside diameter of that part of the well being tested for each 100 feet of depth, the plumbness and alignment of the well shall be corrected by the Contractor. If the faulty alignment and plumbness is not correctable, as determined by the Contracting Officer, the well shall be abandoned as specified in paragraph ABANDONMENT OF WELLS and a new well drilled at no additional cost to the Government.

### 3.3.3 Test for Quality of Water

When the capacity test in the test hole has been completed, and again after the yield in the permanent well and drawdown test or capacity test have been completed, the Contractor shall secure samples of the water in suitable containers, and of sufficient quantity, to have bacterial, physical, and chemical analyses made by a recognized testing laboratory, except that the bacterial analysis may be made by the New Jersey State Board of Health, if desired. Water Quality Analysis shall address each item specified in the Water Quality Analysis Table at the end of this section. Expenses incident to these analyses shall be borne by the Contractor and the results of the analyses shall be furnished to the Contracting Officer. All sampling and analyses shall be performed using EPA and NJDEP approved methods, procedures, and holding times.

### 3.3.4 Aquifer Test

Following completion of the permanent water well and submersible pump, an 8-hour step-draw down test shall be conducted to evaluate the aquifer yield. The step-drawdown test involves increasing pumpage from the well in

successive equal steps or stages. The well shall be pumped at a minimum of four different rates: 25, 50, 75, and 100 percent of the well capacity identified in 3.3.1. The pumping rate for each step shall be held constant and maintained for a minimum of two hours. If the highest pumping rate cannot be achieved, then a rate as high as possible shall be used. Drawdown at the pump well shall be recorded every 1/2 minute during the first 5 minutes after starting the pump; then every 5 minutes for an hour; every 20 minutes for 2 hours; then every 30 minutes for the remainder of the test.

3.4 INSTALLATION OF PERMANENT PUMP

The permanent well pump shall be installed in accordance with Section 02523 SUBMERSIBLE PUMP INSTALLATION, in the well at a minimum depth of 25 feet below the maximum drawdown groundwater level after the drawdown test has been completed. The pump shall be secured at the required elevation as recommended by the pump manufacturer.

3.5 DISINFECTING

After completion of tests of well, or installation of permanent pump, or at time of tests for yield and drawdown test, whichever is later, the wells shall be disinfected by adding chlorine, conforming to AWWA B301, or hypochlorite, conforming to AWWA B300, in sufficient quantity so that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and introduced into the well in an approved manner and shall remain in the well for period of at least 24 hours. Disinfection of well shall be in accordance with any method described in Sections A1 thru A10 of AWWA A100. After the contact period, the well shall be pumped until the residual chlorine content is not greater than 1.0 ppm. The well shall be disinfected and redisinfecting as may be required until two consecutive samples of water are found upon test to be free from Coli Acrogenes group of organisms.

3.6 CONCRETE VAULT

The concrete vault shall be constructed to prevent infiltration of surface water or precipitation into the well. The vault shall be 4 feet square by 4 feet deep and constructed of reinforced concrete. The top of the outer casing shall extend 18 inches above the base of the vault. The base of the slab will be 4 feet below the ground surface. The concrete vault shall be installed in accordance with Section 02571 PRECAST CONCRETE VAULT.

3.7 CLEAN-UP

Upon completion of the well construction and other incidentals, all debris and surplus materials resulting from the work shall be removed from the jobsite.

WATER QUALITY ANALYSIS TABLE

Physical Characteristics

Color	Resistivity in ohms per cubic
Taste	centimeter and 25 degrees C.
Threshold odor number	pH value
Turbidity	Temperature

Chemical Characteristics (Expressed as mg/L)

Arsenic	Total Hardness as CaCO(3)
Barium	VOC (Volatile Organic Compounds)

Chemical Characteristics (Expressed as mg/L)

Cadmium	SOC (Synthetic Organic Compounds)
Chromium	Total Organic Halogens (TOX)
Copper	TOC (Total Organic Carbon)
Lead	Sulphates as SO(4)
Mercury	Chlorides as Cl
Selenium	Bicarbonates as HCO(3)
Silver	Carbonates as CO(3)
Zinc	Nitrates as NO(3)
Fluoride as F	Alkalinity (methyl-orange)
Manganese as Mn (dissolved and total)	(Phenolphthalein) as CaCO(3)
Iron as Fe (dissolved and total)	Silica as SiO(2)
Suspended Solids	Radionuclides
Total Dissolved Solids	
Calcium as Ca	
Magnesium as Mg	
Sodium and Potassium as Na	

-- End of Section --

## SECTION 02523

## SUBMERSIBLE PUMP INSTALLATION

## PART 1 GENERAL

## 1.1 SCOPE OF WORK

The submersible pump installation work will include furnishing and installing the pump, pre-cast concrete well vault with locking steel watertight door, and backfill materials as indicated on the Drawings and specified herein.

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Pump Installation Work Plan; GA.

Proposed plan for installing the concrete vault, well pump and associated piping materials shall be submitted, before beginning work. The plan shall include, but shall not be limited to, the proposed method and equipment to be used for the installation of the concrete vault, submersible pump and associated piping. Work shall not be performed until the pump installation work plan has been approved and deviation form the approved plan will not be permitted without approval of the Contracting Officer.

## 1.3 NOT USED

## 1.4 GENERAL REQUIREMENTS

The concrete vault and submersible pump shall be installed as shown on the Drawings. The concrete vault shall be installed to prevent surface water infiltration into the well pit. The pump shall be an approved submersible pump capable of delivering 70 gpm.

## 1.5 ENVIRONMENTAL PROTECTION

The Contractor shall take necessary precautions to prevent contaminated water, or water having undesirable physical or chemical characteristics, from entering the water supply stratum through the well or by seepage from the ground surface.

## 1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## PART 2 PRODUCTS

## 2.1 SELECT GRANULAR BACKFILL

Select granular backfill shall consist of durable, clean, washed, and graded gravel meeting the requirements of select granular material in Section 703.3 of PennDOT Publication 408.

## 2.2 GEOTEXTILE FILTER FABRIC

A woven, polypropylene geotextile shall be furnished and installed to separate the select backfill from the existing materials. Bias weave material shall be used. This material shall have the following minimum properties:

<u>Fabric Property</u>	<u>Minimum Property</u>
Composition	Polypropylene
Tensile Strength	275 lbs. at 11% Elongation
Apparent Opening Size	No. 70 Standard Sieve
Permeability	0.05 cm/sec

## 2.3 PUMP

The pump for the extraction wells shall be a Model 85S100-8 10-hp pump with Teflon seals as manufactured by Grundfos Pump Corporation, Clovis, California, or an approved equal. Pump requirements for the extraction wells are given in Section 11213 of these Specifications.

## 2.4 DOWNWELL PIPING

Piping shall be nominal two-inch diameter schedule 40, threaded joint, galvanized steel pipe. Threaded connections shall be sealed with PTFE pipe tape and sealed with pipe joint compound made from virgin Teflon.

## 2.5 PITLESS ADAPTER

A stainless steel pitless adapter shall be provided for the water supply well as shown in the Drawings. The adapter should be suited for 6-inch inside diameter well casing. The adapter shall consist of Midwest Adapters Model 6-J-2 welded 2-inch pitless adapter or approved equal.

## 2.6 CONCRETE VAULT

A pre-cast HS-20 traffic rated concrete vault shall have 4 feet by 4 feet by 4 feet inside dimensions, be equipped with a dual door with a HS-20 traffic load rated watertight, spring hinged, locking lid, as manufactured by the BILLO Door Company, or an approved equal. The vault will be constructed without a bottom, with concrete knockout panels on the sides, and in accordance with Section 02571.

## PART 3 EXECUTION

### 3.1 PROCEDURES

The water supply well system shall be constructed to the elevation, lines, grades, and cross sections shown on the Drawings and in accordance with these Specifications, unless otherwise directed by the Contracting Officer.

### 3.2 EXCAVATION

The Contractor shall excavate the well vault to a depth of 4-1/2 feet below ground surface. The depth of excavation shall be to allow for bedding and pipe installation below the frost line. The estimated depths of the well vault are shown on the Drawings. The actual depths of the well vault will be approved by the CLIENT'S representative. The Contractor shall be responsible for measuring and recording the depth of the excavation.

Material excavated from the excavation shall be placed on the spoil pile adjacent to the trench as specified in the approved Work Plan.

### 3.3 BACKFILLING

Backfilling for the concrete vault shall commence as soon as practical. The areas for storing gravel backfill material shall be in accordance with the approved Work Plan.

3.4 Disposal of Trench Excavated Material

The Contractor shall dispose of the excavated material in accordance with the approved Work Plan.

3.5 PUMP AND PIPING

Pump and piping, as shown on the Drawings, shall be installed in the well casing at the appropriate time.

-- End of Section --

## SECTION 02531

## SANITARY SEWERS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM C 425	(1996) Compression Joints for Vitriified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 564	(1995a) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(1996) Vitriified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1991, R 1996) Low-Pressure Air Test of Vitriified Clay Pipe Lines
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(1996) "Fiberglass" (Glass-Fiber-Reinforced

	Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3840	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

## UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl

Chloride (PVC) Profile Wall Gravity Sewer  
Pipe and Fittings Based on Controlled  
Inside Diameter (Nominal Pipe Sizes 4-48  
inch)

## 1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

## PART 2 PRODUCTS

### 2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

#### 2.1.1 NOT USED

#### 2.1.2 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 8 inch through 15 inch diameter.

##### 2.1.2.1 ABS Pipe

ASTM D 2751.

##### 2.1.2.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 15 inches or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8 inch through 48 inch diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

##### 2.1.2.3 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 18 inch through 120 inch. ASTM F 714, size 4 inch through 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills.

##### 2.1.3 Reinforced Plastic Mortar Pipe (RPMP)

ASTM D 3262.

#### 2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

ASTM D 3262.

##### 2.1.4.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

##### 2.1.4.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

#### 2.1.5 Ductile Iron Pipe

Pipe shall conform to AWWA ANSI/AWWA C151/A21.51 unless otherwise shown or specified.

#### 2.1.6 Cast Iron Soil Pipe

Cast iron soil pipe shall conform to ASTM A 74, Class SV, except where Class XH is indicated.

#### 2.1.7 Clay Pipe

ASTM C 700 Extra strength.

### 2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

#### 2.2.1 NOT USED

#### 2.2.2 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

##### 2.2.2.1 Fittings for ABS Pipe

ASTM D 2751.

##### 2.2.2.2 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

##### 2.2.2.3 Fittings for High Density Polyethylene Pipe

ASTM F 894.

##### 2.2.3 Fittings for RPMP

ASTM D 3840.

##### 2.2.4 Fittings for RTRP

ASTM D 3262.

#### 2.2.5 Fittings for Ductile Iron Pipe

Mechanical fittings shall conform to AWWA ANSI/AWWA C110/A21.10, rated for 150 psi. Push-on fittings shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11, rated for 150 psi.

#### 2.2.6 Fittings for Cast Iron Soil Pipe

ASTM A 74.

#### 2.2.7 Fittings for Clay Pipe

ASTM C 700 Extra strength.

### 2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

#### 2.3.1 NOT USED

#### 2.3.2 Plastic Pipe Jointing

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

##### 2.3.2.1 ABS Pipe Jointing

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 12 inches or less in diameter, dimensions and tolerances in accordance with Table 2 of ASTM D 2751.

##### 2.3.2.2 High Density Polyethylene Pipe Jointing

Rubber gasket joints shall conform to ASTM C 443.

#### 2.3.3 RPMP Jointing

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

#### 2.3.4 RTRP Jointing

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

#### 2.3.5 Ductile Iron Pipe Jointing

Push-on joints shall conform to AWWA ANSI/AWWA C111/A21.11. Mechanical joints shall conform to AWWA ANSI/AWWA C111/A21.11 as modified by AWWA ANSI/AWWA C151/A21.51. Flanged joints shall conform to AWWA ANSI/AWWA C115/A21.15.

#### 2.3.6 Cast Iron Soil Pipe Jointing

Rubber gaskets for compression joints shall conform to ASTM C 564. Packing material for caulked joints shall be twisted jute or oakum, tarred type, or asphalt-saturated cellulose-fiber. Joints for acid resisting cast iron soil pipe shall be made with acid resistant non-asbestos packing. The packing shall not contain material which would affect adhesion of the joint sealing material to the pipe. Lead shall be suitable for caulking of joints.

#### 2.3.7 Clay Pipe Jointing

Compression joints shall conform to ASTM C 425.

## 2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

## 2.8 STRUCTURES

### 2.8.1 Double-Wall Fiberglass Holding Tanks

Double-wall fiberglass tank, size and configuration as shown, complete with concrete pad, hold down straps, inlet adapters, manway and louver, with pedestal mounted alarm and controls. Size as indicated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Adjacent Facilities

##### 3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

##### 3.1.1.2 Roads, Railroads, and Airfields

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be as specified for storm drains in Section 02630 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with the corrosion protection as required for the conditions encountered at the site of installation.

##### 3.1.1.3 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

### 3.1.2 Pipe Laying

- a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.
- b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.
- c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
- d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.
- e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

#### 3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 1 inch after caulking.

#### 3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

#### 3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

#### 3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

#### 3.1.2.5 Jointing

Joints between different pipe materials shall be made as specified, using

approved jointing materials.

### 3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

### 3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 0.2 gal per inch diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

### 3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

### 3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 NOT USED

3.5 NOT USED

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

## SECTION 02571

PRE-CAST CONCRETE VAULT  
CONTRACTOR'S OPTION

## PART 1 GENERAL

## 1.1 SCOPE OF WORK

Without intending to limit and/or restrict the volume of work required by this section of the Specifications and the Drawings, the work consists of furnishing all labor, materials, equipment, transportation, services, and appliances necessary to complete the installation of the Pre-cast Concrete Vault, referred to in Section 02521 PERMANENT WATER WELL INSTALLATION. Provisions of the Contract Documents, including requirements of Division 1 of these Specifications, apply to all work of this section. The Contractor shall consult in detail the above-mentioned provisions before proceeding with the work.

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 36	Structural Steel
ASTM C 150	Portland Cement

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Pre-Cast Concrete Vault; FIO.

Detail drawings, fabricator's installation instructions, and product data under provisions of Contract Documents. Submit shop drawings indicating layout, fabrication details, reinforcement, connection details, support items, dimensions, and openings. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

## 1.4 QUALITY ASSURANCE

Materials, manufacturing procedures, and workmanship are subject to inspection and testing in the factory and field. Such inspections and tests are not to relieve the Contractor of responsibility for providing materials and installation procedures in compliance with specified requirements.

## 1.4.1 Remedial Action

The Contractor shall promptly remove and replace materials and workmanship found defective, and shall provide new acceptable work in accordance with Contract requirements.

#### 1.4.2 Coordination

The Contractor shall review installation procedures, and shall coordinate with adjacent work.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered at such intervals as will avoid delays in the work. Deliveries shall be coordinated by the Contractor. Handle pre-cast members in position consistent with their shape and design. Lift and support only from support points. Use lifting or handling devices capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection. Protect members to prevent staining, chipping, or spalling of concrete.

#### 1.6 JOB CONDITIONS

The Contractor shall examine the substrate and conditions under which the work is to be performed. Do not proceed with the work until unsatisfactory substrate conditions have been corrected.

### PART 2 PRODUCTS

#### 2.1 CEMENT

Cement grout shall consist of Portland cement conforming to ASTM C 150, Type I or III, sand and water. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that the well can be properly grouted. No more than 3 percent by weight of bentonite powder may be added to reduce shrinkage. Non shrink; minimum yield strength of 10,000 psi at 28 days.

#### 2.2 AGGREGATE, SAND, WATER, ADMIXTURES

Determined by pre-cast fabricator as appropriate to design requirements.

#### 2.3 CONNECTING AND SUPPORTING DEVICES

ASTM A 36 carbon steel plates, angles, items cast into concrete, or items connected to steel framing members, and inserts; hot-dip galvanized in accordance with ASTM A 153.

#### 2.4 DOORS

Provide HS20 rated dual doors, with spring leaf hinges, lock, and watertight seals as manufactured by the BILCO Door Company or approved equal. The door shall be cast into and an integral part of the vault structure. The doors shall be sized to withstand design loads in a restrained condition (vertical load) for a HS20 highway rating. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges. Design system to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings

### PART 3 EXECUTION

#### 3.1 FINISHING

Ensure exposed to view finish surfaces of pre-cast concrete members are

uniform in color and appearance. Normal plant finish with fins and protrusions removed, ground edges and ends, and flat face surfaces.

### 3.2 TOLERANCES

The Maximum Variation from Nominal Dimension will be no more than 1 inch.  
The Maximum Misalignment of Anchors, Inserts, Openings will be no more than 1/8 inch.

### 3.3 INSTALLATION

Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

-- End of Section --

## SECTION 02621

## FOUNDATION DRAINAGE SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 252	(1994) Corrugated Polyethylene Drainage Tubing
AASHTO M 294	(1994) Corrugated Polyethylene Pipe, 305- to 915-mm (12- to 36 in.) Diameter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM C 33	(1993) Concrete Aggregates
ASTM D 1117	Nonwoven Fabrics (Trapezoidal Tear Test)
ASTM D 1682	Breaking Load and Elongation of Textile Fabric
ASTM D 751	Test Coated Fabric
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 405	(1996) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 667	(1985) Large Diameter Corrugated Polyethylene Tubing and Fittings
ASTM F 758	(1993) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Materials; FIO.

Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 DELIVERY, STORAGE AND HANDLING

Materials placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Plastic pipe shall not be exposed to direct sunlight for more than 6 months from time of manufacturer to installation.

PART 2 PRODUCTS

2.1 MATERIALS

Pipe for foundation drainage system shall be of the type and size indicated. Appropriate transitions, adapters, or joint details shall be used where pipes of different types or materials are connected.

2.1.1 NOT USED

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 Cast-Iron Soil Pipe

ASTM A 74, extra-heavy.

2.1.10 NOT USED

2.1.11 NOT USED

2.1.12 NOT USED

2.1.13 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.13.1 Corrugated Polyethylene (PE) Drainage Pipe

The Contractor shall furnish ASTM F 405 heavy duty for pipe 3 to 6 inches in diameter inclusive, ASTM F 667 for pipe 8 to 24 inches in diameter; or AASHTO M 252 for pipe 3 to 10 inches in diameter or AASHTO M 294 for pipe 12 to 24 inches in diameter. Fittings shall be pipe manufacturer's standard type and shall conform to the indicated specification.

2.1.13.2 Acrylonitrile-Butadiene-Styrene (ABS) Pipe

ASTM D 2751, with a maximum SDR of 35.

#### 2.1.13.3 Polyvinyl Chloride (PVC) Pipe

ASTM F 758, Type PS 46, ASTM D 3034, or ASTM F 949 with a minimum pipe stiffness of 46 psi.

#### 2.1.13.4 Circular Perforations in Plastic Pipe

Circular holes shall be cleanly cut, not more than 5/16 inch or less than 3/16 inch in diameter, and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 3 inches apart, center-to-center, along rows. The rows shall be approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket and perforations shall continue at uniform spacing over the entire length of the pipe. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

#### 2.1.13.5 Slotted Perforations in Plastic Pipe

Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch or be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing; 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing; and 2-1/2 inches on 10 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe. The water inlet area shall be a minimum of 0.5 square inch per linear foot of tubing. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

#### 2.1.14 Fittings

Fittings shall be of compatible materials for pipe, of corresponding weight and quality, and as specified herein.

#### 2.1.15 Cleanouts and Piping Through Walls

Cleanout pipe and fittings and piping through walls and footings shall be cast-iron soil pipe. Each cleanout shall have a brass ferrule and a cast-brass screw-jointed plug with socket or raised head for wrench.

#### 2.1.16 NOT USED

#### 2.1.17 Bedding and Pervious Backfill for Foundation Drains

Bedding and pervious backfill shall be coarse aggregate conforming to ASTM C 33, size number 8.

#### 2.1.18 Protective Covering for Pervious Backfill

Protective covering shall be filter fabric as specified below.

### 2.2 DRAINAGE COMPOSITES

The drainage composite shall consist of a filter fabric and a drainage mat meeting the requirements specified below. The filter fabric and drainage mat may be separate materials or a composite of the two materials bonded

together during manufacture.

2.2.1 Filter Fabric

Filter fabric shall be non-woven pervious sheet of long chain polymeric filaments of polypropylene or polyester, formed by needle punching into a pattern with distinct and measurable openings. The filter fabric shall provide an equivalent opening size (EOS) no finer than the US Standard Sieve No. 120 and no coarser than the US Standard Sieve No. 70 EOS joined accordingly to the manufacturer's recommendations. The composite shall be laid smooth and free of tension, stress, wrinkles, folds, or creases. The drainage composite shall be placed in accordance with the manufacturer's recommendations. Care shall be taken during installation to prevent damage to the drainage composite, waterproofing, or the structure.

2.2.1.1 Contractor's Responsibility

Any drainage composite with defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, storage, handling, installation, or backfilling will be rejected by the Contracting Officer and will be replaced or repaired by the Contractor, as directed, at no additional cost to the Government.

2.2.2 Drainage Mat

The drainage mat shall be nylon, polyethylene or other high-strength plastic of adequate size to carry groundwater from the filter fabric to the drainage outlet and of adequate strength to prevent crushing during installation or by lateral earth pressures during in-service use. The mat configuration shall provide multi-directional water flow.

Table I. Physical Strength Requirements

<u>Physical Property</u>	<u>Test Procedure</u>	<u>Acceptable Test Results</u>
Tensile Strength (unaged fabric)*	ASTM D 1682, Grab Test Method using 1-inch square jaws and a travel rate of 12 inches per minute	215 pounds per inch minimum in any principle direction
Puncture Strength (unaged fabric)*	ASTM D 751, Tension Testing Machine with Ring Clamp; steel ball replaced with a 5/16-inch diameter solid steel cylinder with a flat tip centered within the ring clamp	90 pound minimum
Elongation at Failure (unaged fabric)*	ASTM D 1682	60 percent minimum
Trapezoidal Tear Strength (unaged fabric)*	ASTM D 1117	80 pounds minimum

\*UNAGED FABRIC IS DEFINED AS FABRIC IN THE CONDITION AS RECEIVED FROM THE MANUFACTURER OR DISTRIBUTOR.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 Extent

Foundation drainage shall be furnished and installed as a complete system as shown.

### 3.1.2 Outlet Connections

Foundation pipe shall be terminated as shown.

### 3.1.3 Drainage Lines

Drainage lines shall be constructed of perforated pipe.

### 3.1.4 Outlet Lines

Outlet lines shall be constructed of closed-joint nonperforated, nonporous pipe.

## 3.2 INSTALLATION

### 3.2.1 Trenching and Excavation

Required trenching and excavation shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Trenches shall be kept dry during installation of drainage system. Changes in direction of drain lines shall be made with 1/8 bends. Wye fittings shall be used at intersections.

### 3.2.2 Bedding

Graded bedding, minimum 6 inches in depth, shall be placed in the bottom of trench for its full width and length and compacted as specified prior to laying of foundation drain pipe. Each section shall rest firmly upon the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, the bedding shall fully support the lower quadrant of the pipe.

### 3.2.3 Pipe Laying

Drain lines shall be laid to true grades and alignment with a continuous fall in the direction of flow. Bells of pipe sections shall face upgrade. Interior of pipe shall be cleaned thoroughly before being laid. When drain lines are left open for connection to discharge lines, the open ends shall be temporarily closed and the location marked with wooden stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and relaid at no additional cost to the Government. Perforated corrugated polyethylene drainage tubing and plastic piping shall be installed in accordance with manufacturer's specifications and as specified herein. Tubing and piping with physical imperfections shall not be installed.

### 3.2.4 Jointing

#### 3.2.4.1 Perforated and Porous Pipes

Perforated drain pipes shall be laid with closed joints.

#### 3.2.4.2 Nonperforated Drain Tile

Nonperforated and plain-end drain tile shall be laid with 1/8 to 1/4 inch open joints. Open joints shall be covered or wrapped. Covered joints shall have one thickness of the cover material placed over the joint. Material shall overlap the joint not less than 4 inches on each side and cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. Strips of wire cloth wrapping material 3 inches wide shall be used for wrapped joints, with ends fastened

together.

3.2.4.3 NOT USED

3.2.4.4 NOT USED

3.2.4.5 Joints of Cast-Iron Pipe

Joints of cast-iron pipe or connections between cast-iron and porous concrete pipes shall be caulked with oakum gasket and filled with lead.

3.2.4.6 NOT USED

3.2.4.7 NOT USED

3.2.4.8 ABS Pipe

ABS pipe shall be joined using solvent cement or elastomeric joints and shall be in accordance with ASTM D 2751, with dimensions and tolerances in accordance with TABLE II therein.

3.2.4.9 PVC Pipe

PVC pipe joints shall be in accordance with ASTM D 3034, ASTM D 3212, or ASTM F 949.

3.2.4.10 Corrugated Polyethylene

Corrugated polyethylene (PE) pipe joints shall be in accordance with ASTM F 405 or ASTM F 667.

3.2.5 Outlet Lines

The outlet end of drain lines connecting with an open gutter or outfall shall be covered with a removable wire basket of 16-mesh copper or bronze wire cloth fastened with brass or wire straps.

3.2.6 Backfilling

After joints and connections have been inspected and approved, the specified pervious backfill material shall be placed a minimum width of 6 inches on each side of the pipe or tile for the full width of the trench and full width between pipe and adjacent walls and 12 inches above the top of the pipe. The backfill shall be placed preventing displacement of or injury to the pipe or tile. A protective covering, as specified, shall be placed over the pervious backfill for the full width of the trench before regular backfill is placed. Backfill shall be compacted as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.7 Cleanouts

Cleanouts shall be provided in locations indicated. Cleanouts in unpaved areas shall be set in 12 by 12 by 4 inch concrete blocks.

3.2.8 Drainage Composites

The drainage composite shall be rolled circumferentially across the structure with ends of the composite extended into the gravel filter material surrounding the footing drains. Circumferential seams shall be overlapped a minimum of 18 inches and joined according to the manufacturer's recommendations. Care shall be taken during installation to prevent damage to the drainage composite, waterproofing, or the structure.

-- End of Section --

SECTION 02630  
STORM-DRAINAGE SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges
AASHTO M 198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 294	(1994) Corrugated Polyethylene Pipe, 305- to 915- mm (12-to 36 in.) Diameter
AASHTO MP6	(1995) Corrugated Polyethylene Pipe 1050 and 1200 mm Diameter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 929/A 929M	(1996) Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B 26/B 26M	(1997) Aluminum-Alloy Sand Castings
ASTM C 139	(1997) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1997a) Mortar for Unit Masonry
ASTM C 425	(1997) Compression Joints for Vitriified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 789	(1995a) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and

## Sewers

ASTM C 850	(1995a) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 ft of Cover Subjected to Highway Loadings
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Pipe and Drainage Structures; FIO.

Shop drawings and manufacturer's cut sheets of precast concrete endwalls, polyethylene pipe, catch basins, and grates.

## SD-06 Instructions

Placing Pipe; FIO.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

## SD-13 Certificates

Resin Certification; FIO. Hydrostatic Test on Watertight Joints; FIO. Determination of Density; FIO. Frame and Cover for Gratings; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

## 1.4 DELIVERY, STORAGE, AND HANDLING

## 1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

## 1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

## PART 2 PRODUCTS

## 2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 NOT USED

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.9.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.9.2 Corrugated PE Pipe

AASHTO M 294, Type S, for pipes 12 to 36 inches and AASHTO MP6, Type S or D, for pipes 42 to 48 inches produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 315412C or 324420C. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543

2.1.9.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
		Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.2 DRAINAGE STRUCTURES

### 2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

### 2.2.2 Precast Reinforced Concrete Box

For highway loadings with 2 feet of cover or more or subjected to dead load only, ASTM C 789; for less than 2 feet of cover subjected to highway loading, ASTM C 850.

## 2.3 MISCELLANEOUS MATERIALS

### 2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231.

The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

### 2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities.

The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

### 2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

### 2.3.4 NOT USED

### 2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

### 2.3.6 NOT USED

### 2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

## 2.3.8 Joints

### 2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete sections. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

### 2.3.8.2 NOT USED

### 2.3.8.3 NOT USED

### 2.3.8.4 NOT USED

### 2.3.8.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

### 2.3.8.6 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-16, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

### 2.3.8.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

## 2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

## 2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48, Class 30B or 35B. Shape and size shall be as indicated.

## 2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

### 2.6.1 PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Test requirements for joints in PE plastic pipe shall conform to ASTM D 3212.

## PART 3 EXECUTION

## 3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and Section 02300 EARTHWORK and the requirements specified below.

## 3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be adequate for satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

## 3.1.2 NOT USED

## 3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheet piling, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

## 3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

## 3.2.1 NOT USED

## 3.2.2 NOT USED

## 3.2.3 NOT USED

## 3.2.4 NOT USED

## 3.2.5 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

## 3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as

necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 NOT USED

3.3.2 NOT USED

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.4 NOT USED

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, precast reinforced concrete, complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in

place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

### 3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches.

### 3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

### 3.7.4 Compaction

#### 3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

#### 3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than that of the surrounding material.

### 3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density

relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

-- End of Section --

## SECTION 02731

## AGGREGATE SURFACE COURSE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3740	(1996) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation;

submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data.

SD-09 Reports

Sampling and Testing; GA. Density Test; GA.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Test results from samples, not less than 30 days before material is required for the work. Results of laboratory tests for quality control purposes, for approval, prior to using the material.

1.5 EQUIPMENT

All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

1.6 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by the Contractor, subject to approval. If the Contractor elects to establish its own testing facilities, approval of such facilities will be based on compliance with ASTM D 3740. No work requiring testing will be permitted until the Contractor's facilities have been inspected and approved.

1.6.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.6.2 Testing

1.6.2.1 Gradation

Aggregate gradation shall be made in conformance with ASTM C 117, ASTM C 136, and ASTM D 422. Sieves shall conform to ASTM E 11.

1.6.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.6.3 Approval of Materials

The source of the material to be used for producing aggregates shall be selected 14 days prior to the time the material will be required in the work. Approval of sources not already approved by the Corps of Engineers will be based on an inspection by the Contracting Officer. Tentative approval of materials will be based on appropriate test results on the

aggregate source. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted surface course.

1.7 WEATHER LIMITATIONS

Aggregate surface courses shall not be constructed when the ambient temperatures is below 35 degrees F and on subgrades that are frozen or contain frost. It shall be the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Surfaces damaged by freeze, rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor shall be responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction and proof rolling operations have been completed.

2.1.1 Coarse Aggregates

The material retained on the No. 4 sieve shall be known as coarse aggregate. Coarse aggregates shall be reasonably uniform in density and quality. The coarse aggregate shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ASTM C 131. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein.

2.1.2 Fine Aggregates

The material passing the No. 4 sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

Gradation requirements specified in TABLE I shall apply to the completed aggregate surface. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface roads and airfields. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES

Sieve Designation	No. 2
1 in.	100
3/8 in.	60-100
No. 4	50-85
No. 10	40-70

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES

Sieve Designation	No. 2
No. 40	24-45
No. 200	8-15

## 2.2 LIQUID LIMIT AND PLASTICITY INDEX REQUIREMENTS

The portion of the completed aggregate surface course passing the No. 40 sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

## PART 3 EXECUTION

### 3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specification requirements in the specified time limit. Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

### 3.2 STOCKPILING MATERIALS

Prior to stockpiling the material, the storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled in such a manner that will prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

### 3.3 PREPARATION OF UNDERLYING COURSE SUBGRADE

The subgrade, including shoulders, shall be cleaned of all foreign substances. At the time of surface course construction, the subgrade shall contain no frozen material. Ruts or soft yielding spots in the subgrade areas having inadequate compaction and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompacting to density requirements specified in Section 02300 EARTHWORK. The completed subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the surface course is placed.

### 3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course shall be maintained by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CONTRACT REQUIREMENTS.

### 3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the material and a uniform optimum water content for compaction. The Contractor shall make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

### 3.6 LAYER THICKNESS

The aggregate material shall be placed on the subgrade in layers of uniform thickness. When a compacted layer of 6 inches or less is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

### 3.7 COMPACTION

Each layer of the aggregate surface course shall be compacted with approval compaction equipment. The water content during the compaction procedure shall be maintained at optimum or at the percentage specified by the Contracting Officer. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

### 3.8 NOT USED

### 3.9 EDGES OF AGGREGATE-SURFACED ROAD

Approved material shall be placed along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least 1 foot of shoulder width shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the surface course.

### 3.10 SMOOTHNESS TEST

The surface of each layer shall not show any deviations in excess of 3/8 inch when tested with a 10 foot straightedge applied both parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by the Contractor by removing material, replacing with new material, or reworking existing material and compacting, as directed.

### 3.11 THICKNESS CONTROL

The completed thickness of the aggregate surface course shall be within 1/2 inch, plus or minus, of the thickness indicated on plans. The thickness of the aggregate surface course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of the aggregate surface course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course. When the measured thickness of the aggregate surface course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to the Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed. Where the measured thickness of the aggregate surface course is more than 1/2 inch) thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated. When the average job thickness fails to meet this criterion, the Contractor shall, at no additional expense to the Government, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed.

### 3.12 DENSITY TESTS

Density shall be measured in the field in accordance with ASTM D 1556, ASTM

D 2167, or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals, as directed.

### 3.13 WEAR TEST

Wear tests shall be made in conformance with ASTM C 131.

### 3.14 MAINTENANCE

The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --

## SECTION 02741

## BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density (Unit Weight) and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 183	(1995a) Sampling and the Amount of Testing of Hydraulic Cement
ASTM D 5	(1995) Penetration of Bituminous Materials
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous Paving Mixtures
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 946	(1982; R 1993) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 1856	(1995a) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock

ASTM D 3515 (1996) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

ASTM D 4791 (1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

## NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT)

NJDOT Standard Specifications for Road and Bridge Construction (Current Edition)

## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-09 Reports

Bituminous Pavement; GA.

Copies of test results.

## SD-14 Samples

Bituminous Pavement; GA.

Samples of the materials in the quantities indicated below for the job mix formula when requested by the Contracting Officer.

Aggregate and mineral filler (if needed) to be blended in approximately the same proportions as used in the project	200 pounds
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Asphalt Cement	5 gallons
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Aggregate samples when new sources are developed, with a plan for operation, 14 days before starting production. Samples of the asphalt cement specified, not less than 7 days before production.

## 1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

## 1.4.1 General

The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.

## 1.4.2 Mixing Plants

The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). The plant shall have a minimum capacity of 250 tons per hour. Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

#### 1.4.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 12-foot straightedge for each bituminous paver. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

#### 1.5 WEATHER LIMITATIONS

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 40 degrees F.

#### 1.6 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

#### 1.7 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

##### 1.7.1 Plan Grade

The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

##### 1.7.2 Surface Smoothness

When a 12-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 1/4 inch from the straightedge.

#### 1.8 GRADE CONTROL

Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work in accordance with the Special Contract Requirements. Elevations of bench marks used by the Contractor for controlling pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

#### 1.9 SAMPLING AND TESTING

##### 1.9.1 Aggregates

##### 1.9.1.1 General

When requested by the Contracting Officer, samples of aggregates shall be furnished by the Contractor for approval of aggregate sources and stockpiles prior to the start of production and at times during production of the bituminous mixtures. Times and points of sampling will be designated by the Contracting Officer. Samples will be the basis of approval of specific sources or stockpiles of aggregates for aggregate requirements. Unless otherwise directed, ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler. All tests necessary to determine compliance with

requirements specified herein will be made by the Government.

#### 1.9.1.2 Sources

Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, evidence shall be submitted 30 days before starting production, indicating that the central-plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. The Contracting Officer will make such tests and other investigations as necessary to determine whether aggregates meeting requirements specified herein can be produced from proposed sources. If a sample of material from a new source fails to meet specification requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample will be at the expense of the Contractor. Approval of the source of aggregate does not relieve the Contractor of responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

#### 1.9.2 Bituminous Materials

When requested by the Contracting Officer, samples of bituminous materials shall be obtained by the Contractor; sampling shall be in accordance with ASTM D 140. Tests necessary to determine conformance with requirements specified herein will be performed by the Government without cost to the Contractor. Sources where bituminous materials are obtained shall be selected in advance of the time when materials will be required in the work. In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure some condition of handling or storage has not been detrimental to the bituminous material. The samples will be taken by the Contractor and tested by the Contracting Officer.

#### 1.9.3 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by the Contracting Officer.

### 1.10 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

#### 1.10.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

#### 1.10.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh buckets shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

#### 1.11 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of

materials; and checking temperatures maintained in preparation of the mixtures.

## PART 2 PRODUCTS

### 2.1 BITUMINOUS HOT MIX

Bituminous hot mix shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the qualities and in the proportions specified and shall conform to the requirements contained in NJDOT 903 for I-4 surface course and I-2 base (intermediate) course.

#### 2.1.1 Aggregates

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screening, sand, and mineral filler, as required. The portion of materials retained on the No. 4 sieve shall be known as coarse aggregate, the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate, and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in TABLE I. TABLE I is based on aggregates of uniform specific gravity; the percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentage passing various sieves may be changed by the Contracting Officer when aggregates vary by more than 0.2 in specific gravity.

Aggregate shall meet the requirements of the New Jersey Department of Transportation for bituminous hot mix pavements.

##### 2.1.1.1 Coarse Aggregate

Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

- a. Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.
- b. Percentage of loss shall not exceed 50 after five cycles performed in accordance with ASTM C 88, using magnesium sulfate.
- c. The dry weight of crushed slag shall not be less than 75 pcf, as determined in accordance with ASTM C 29/C 29M.
- d. Crushed gravel retained on the No. 4 sieve and each coarser sieve shall contain at least 75 percent by weight of crushed pieces having one or more fractured faces with the area of each face equal to at least 75 percent of the smallest midsectional area of piece. When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as two fractured faces.
- e. Particle shape of crushed aggregates shall be essentially cubical. The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with ASTM D 4791.

##### 2.1.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles, including natural sand or crushed stone, slag, or gravel that meets requirements for wear and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve. This requirement shall apply to the material before blending with natural sand when blending is necessary. Quantity of natural sand to be added to the wearing- and intermediate-course mixtures shall not

exceed 25 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter. Percentage of loss shall not exceed 50 after five cycles of the soundness test performed in accordance with ASTM C 88, using magnesium sulfate.

2.1.1.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

Grain size shall be determined in accordance with ASTM D 422.

2.1.2 Bituminous Material

Asphalt cement shall conform to ASTM D 946, Grade AC-10.

2.1.3 Additives

The use of additives such as antistripping and antifoaming agents is subject to approval.

2.2 PROPORTIONING OF MIXTURE

2.2.1 Job Mix Formula

The JMF for the bituminous mixture will be furnished by the Contractor to the Contracting Officer. No payment will be made for mixtures produced prior to the approval of the JMF. The formula will indicate the percentage of each stockpile and mineral filler, the percentage of each size aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. Tolerances are given in TABLE II for asphalt content, temperature, and aggregate grading for tests conducted on the mix as discharged from the mixing plant; however, the final evaluation of aggregate gradation and asphalt content will be based on paragraph ACCEPTABILITY OF WORK. Bituminous mix that deviates more than 25 degrees F from the JMF shall be rejected. The JMF may be adjusted during construction to improve paving mixtures, as directed, without adjustments in the contract unit prices.

TABLE II. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	4 percent
Aggregate passing Nos. 100 and 200 sieves	2 percent
Bitumen	0.25 percent
Temperature of mixing	25 degrees F

2.2.2 Test Properties of Bituminous Mixtures

Finished mixture shall meet requirements described below. All samples will be compacted with 50 blows of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

2.2.2.1 Stability, Flow, and Voids

Requirements for stability, flow, and voids are shown in TABLES III and IV for nonabsorptive and absorptive aggregates, respectively.

TABLE III. NONABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
	<hr/>	<hr/>
Stability minimum, pounds	500	500
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	3-5	4-6
Voids filled with bitumen, percent (2)	75-85	65-75

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

TABLE IV. ABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
	<hr/>	<hr/>
Stability minimum, pounds	500	500
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	2-4	3-5
Voids filled with bitumen, percent (2)	80-90	70-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

a. When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet requirements in TABLE III.

b. When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in TABLE IV.

### PART 3 EXECUTION

#### 3.1 BASE COURSE CONDITIONING

The surface of the base course will be inspected for adequate compaction and surface tolerances specified in Section 02722 GRADED CRUSHED AGGREGATE BASE COURSE. Unsatisfactory areas shall be corrected.

#### 3.2 NOT USED

#### 3.3 PREPARATION OF BITUMINOUS MIXTURES

Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

#### 3.4 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with ASTM D 2216; the weight of the sample shall be at least 500 grams. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

#### 3.5 STORAGE OF BITUMINOUS PAVING MIXTURE

Storage shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

#### 3.6 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

#### 3.7 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of the intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

#### 3.8 PRIME COATING

Surfaces of previously constructed base course shall be sprayed with a coat of bituminous material conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS.

#### 3.9 TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS.

#### 3.10 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided.

##### 3.10.1 Offsetting Joints

The wearing course shall be placed so that longitudinal joints of the wearing course will be offset from joints in the intermediate course by at least 1 foot. Transverse joints in the wearing course shall be offset by

at least 2 feet from transverse joints in the intermediate course.

### 3.10.2 General Requirements for Use of Mechanical Spreader

Range of temperatures of mixtures, when dumped into the mechanical spreader, shall be as determined by the Contracting Officer. Mixtures having temperatures less than 225 degrees F when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to center line areas with crowned sections or high side of areas with one-way slope shall be as directed. Each lot of material placed shall conform to requirements specified in paragraph ACCEPTABILITY OF WORK. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected.

### 3.10.3 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by use of a lute. Excess mixture shall be removed and wasted.

### 3.10.4 Handspreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

## 3.11 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness will be checked in each lot of completed pavement by the Contracting Officer for compliance and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. After the Contractor is assured of meeting crown, grade, and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

### 3.11.1 Testing of Mixture

At the start of the plant operation, a quantity of mixture shall be prepared that is sufficient to construct a test section at least 50 feet long, two spreader widths wide and of thickness to be used in the project. Mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with the requirements specified above. This test section shall be tested and evaluated as a lot and shall conform to all specified requirements. If test results are satisfactory, the test

section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately, and test section will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. Additional test sections, as directed, shall be constructed and sampled for conformance to specification requirements. In no case shall the Contractor start full production of an intermediate or wearing course mixture without approval.

### 3.11.2 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

### 3.12 JOINTS

#### 3.12.1 General

Joints between old and new pavements, between successive work days, or joints that have become cold (less than 175 degrees F) shall be made to ensure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS. Material shall be applied far enough in advance of placement of a fresh mixture to ensure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

#### 3.12.2 Transverse Joints

The roller shall pass over the unprotected end of a strip of freshly placed material only when placing is discontinued or delivery of the mixture is interrupted to the extent that the material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of a strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

#### 3.12.3 Longitudinal Joints

Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density specified in paragraph ACCEPTABILITY OF WORK.

### 3.13 ACCEPTABILITY OF WORK

#### 3.13.1 NOT USED

#### 3.13.2 NOT USED

#### 3.13.3 NOT USED

3.13.4 NOT USED

3.13.5 NOT USED

3.13.6 Surface Smoothness

After completion of final rolling of a lot, the compacted surface will be tested by the Contracting Officer with a 12-foot straightedge. Measurements will be made perpendicular to and across all mats at distances along the mat not to exceed 25 feet. Location and deviation from straightedge of all measurements will be recorded. Any joint or mat area surface deviation which exceeds the tolerance given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

-- End of Section --

## SECTION 02748

## BITUMINOUS TACK AND PRIME COATS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 81 (1992) Cut-Back Asphalt (Rapid-Curing Type)

AASHTO T 40 (1978; R 1983) Sampling Bituminous  
Materials

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 140 (1993) Sampling Bituminous Materials

ASTM D 2028 (1976; R 1992) Cutback Asphalt  
(Rapid-Curing Type)

ASTM D 2995 (1993) Determining Application Rate of  
Bituminous Distributors

## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Tests; FIO.

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

## 1.4 PLANT, EQUIPMENT, MACHINES AND TOOLS

## 1.4.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

## 1.4.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and

equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

#### 1.4.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

#### 1.5 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 50 degrees Fahrenheit or above and when the temperature has not been below 35 degrees Fahrenheit for the 12 hours prior to application.

### PART 2 PRODUCTS

#### 2.1 TACK COAT

Cutback asphalt shall conform to ASTM D 2028 or AASHTO M 81 Grade RC-70.

#### 2.2 PRIME COAT

Cutback asphalt shall conform to ASTM D 2028 or AASHTO M 81, Grade RC-70 or RC-250.

### PART 3 EXECUTION

#### 3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

#### 3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

##### 3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

##### 3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

#### 3.3 APPLICATION TEMPERATURE

##### 3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

### 3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

#### Liquid Asphalts

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RC-70	120-200 degrees F*
RC-250	165-250 degrees F*

\*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

### 3.4 APPLICATION

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

### 3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

### 3.6 FIELD QUALITY CONTROL

Samples of the bituminous material used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

### 3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

#### 3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in

accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

### 3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

### 3.7.3 NOT USED

### 3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 02763  
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952 (Rev D) Paint, Traffic and Airfield  
Marking, Waterborne (Metric)

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA.

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

SD-06 Instructions

Mixing, Thinning and Application; FIO.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-08 Statements

Qualifications; FIO.

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-09 Reports

Material Tests; GA.

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-13 Certificates

Volatile Organic Compound (VOC) Content; GA.

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

#### 1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

#### 1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

##### 1.5.1 NOT USED

##### 1.5.2 NOT USED

##### 1.5.3 NOT USED

##### 1.5.4 NOT USED

##### 1.5.5 NOT USED

##### 1.5.6 NOT USED

##### 1.5.7 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

#### 1.6 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

#### 1.7 MAINTENANCE OF TRAFFIC

##### 1.7.1 NOT USED

##### 1.7.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

#### 1.8 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

## PART 2 PRODUCTS

### 2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

### 2.2 NOT USED

#### 2.2.1 NOT USED

#### 2.2.2 NOT USED

#### 2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

#### 2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

#### 3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

### 3.1.2 NOT USED

### 3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

## 3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

### 3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint.

Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

#### 3.2.1.1 Rate of Application

a. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

#### 3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

-- End of Section --

## SECTION 02770

## CONCRETE SIDEWALKS AND CURBS AND GUTTERS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 (1994) Steel Welded Wire Fabric, Plain,  
for Concrete Reinforcement

ASTM C 31/C 31M (1996) Making and Curing Concrete Test  
Specimens in the Field

ASTM C 143 (1990a) Slump of Hydraulic Cement Concrete

ASTM C 171 (1997) Sheet Materials for Curing Concrete

ASTM C 172 (1990) Sampling Freshly Mixed Concrete

ASTM C 173 (1996) Air Content of Freshly Mixed  
Concrete by the Volumetric Method

ASTM C 231 (1997) Air Content of Freshly Mixed  
Concrete by the Pressure Method

ASTM C 309 (1997) Liquid Membrane-Forming Compounds  
for Curing Concrete

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint  
Filler for Concrete Paving and Structural  
Construction (Nonextruding and Resilient  
Bituminous Types)

ASTM D 1752 (1984; R 1996) Preformed Sponge Rubber and  
Cork Expansion Joint Fillers for Concrete  
Paving and Structural Construction

ASTM D 3405 (1996) Joint Sealants, Hot-Applied, for  
Concrete and Asphalt Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 527 (1988) Standard Specification for Joint  
Sealants, Cold-Applied,  
Non-Jet-Fuel-Resistant, for Rigid and  
Flexible Pavements

## 1.2 NOT USED

### 1.3 NOT USED

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-09 Reports

Field Quality Control; GA.

Copies of all test reports within 24 hours of completion of the test.

#### SD-18 Records

Concrete; FIO.

Copies of certified delivery tickets for all concrete used in the construction.

### 1.5 WEATHER LIMITATIONS

#### 1.5.1 Placing During Cold Weather

Concrete placement shall be discontinued when the air temperature reaches 40 degrees F and is falling. Placement may begin when the air temperature reaches 35 degrees F and is rising. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

#### 1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F.

### 1.6 PLANT, EQUIPMENT, MACHINES, AND TOOLS

#### 1.6.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

### 1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

## PART 2 PRODUCTS

### 2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

#### 2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

#### 2.1.2 Slump

The concrete slump shall be 3 inches where determined in accordance with ASTM C 143.

#### 2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A, ASTM A 616/A, or ASTM A 617/A. Wire mesh reinforcement shall conform to ASTM A 185.

### 2.2 CONCRETE CURING MATERIALS

#### 2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

#### 2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

#### 2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

### 2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

### 2.4 JOINT FILLER STRIPS

#### 2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

#### 2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 3/8 inch thick, unless otherwise indicated.

## 2.5 JOINT SEALANTS

### 2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

### 2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

## 2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 2 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

### 2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

### 2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

## PART 3 EXECUTION

### 3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 02300 EARTHWORK.

#### 3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

#### 3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a

template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

### 3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

## 3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

### 3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

### 3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

## 3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

### 3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a wood float, bull float, or darby, edged and broom finished.

### 3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.

### 3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

### 3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straight edge. Permissible deficiency in section thickness will be up to 1/4 inch.

## 3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

### 3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

### 3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

### 3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

### 3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

### 3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straight edge. Permissible deficiency in section thickness will be up to 1/4 inch.

## 3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width.

Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

### 3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

### 3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 3/8 inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material.

Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

### 3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

## 3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

### 3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

### 3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 3/8 inch in width shall be provided at intervals not exceeding 20 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and

gutter contraction-joints shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

### 3.7 CURING AND PROTECTION

#### 3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

##### 3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

##### 3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

##### 3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing

compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

### 3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

### 3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

### 3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

#### 3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

#### 3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F.

## 3.8 FIELD QUALITY CONTROL

### 3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

### 3.8.2 Concrete Testing

### 3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

### 3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231.

ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector.

If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

### 3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

### 3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine.

If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

### 3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

## 3.9 SURFACE DEFICIENCIES AND CORRECTIONS

### 3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

### 3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or

by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch.

Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

### 3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

## SECTION 02821

## FENCING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 121	(1992a) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(1995) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1992) Aluminum-Coated Steel Barbed Wire
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM F 626	(1996) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Chain Link Fence; GA.

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

#### SD-19 Operation and Maintenance Manuals

### PART 2 PRODUCTS

#### 2.1 FENCE FABRIC

Fence fabric shall conform to the following:

##### 2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 2.0 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

#### 2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

#### 2.3 POSTS

##### 2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II, formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

#### 2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line

posts are furnished.

## 2.5 WIRE

### 2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

## 2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

## 2.7 NOT USED

## 2.8 CONCRETE

ASTM C 94, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

### 3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 2 inch clearance between the bottom of the fabric and finish grade.

### 3.3 POST INSTALLATION

#### 3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in

concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

### 3.4 RAILS

#### 3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

### 3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12 foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

### 3.6 TENSION WIRES

Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 1 foot of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

### 3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 24 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 plus or minus 1/2 inch above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the

panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

### 3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

#### 3.8.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in a manner to prevent easy removal with hand tools. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

### 3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal. For farm style fencing, standard metal gate assemblies with frame and fittings necessary for complete installation or wood gates shall be furnished as shown.

### 3.10 NOT USED

### 3.11 GROUNDING

Fences crossed by overhead powerlines in excess of 600 volts shall be grounded as specified in Section 13100 LIGHTNING PROTECTION SYSTEM. Electrical equipment attached to the fence shall be grounded as specified in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL or Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

-- End of Section --

## SECTION 02921

## SEEDING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Aug 95) Federal Seed Act Regulations Part 201

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials  
 ASTM D 977 (1991) Emulsified Asphalt  
 ASTM D 2028 (1976; R 1992) Cutback Asphalt (Rapid-Curing Type)  
 ASTM D 4972 (1995a) pH of Soils  
 ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes  
 ASTM D 5883 (1996) Standard Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

## NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT)

NJDOT Standard Specifications for Road and Bridge Construction (Current Edition)

## NEW JERSEY STATE SOIL CONSERVATION COMMITTEE (NJSSCC)

NJSSCC Standards for Soil Erosion and Sediment Control in New Jersey, 1987

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Surface Erosion Control Material; FIO. Chemical Treatment Material; FIO.

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

## SD-07 Schedules

Equipment; FIO.

A listing of equipment to be used for the seeding operation.

## SD-08 Statements

Delivery; GA.

Delivery schedule.

Topsoil; FIO.

Availability of topsoil from the stripping and stock piling operation.

## SD-09 Reports

Equipment Calibration; FIO.

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; GA.

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

## SD-13 Certificates

Seed; GA. Topsoil; GA. pH Adjuster; FIO. Fertilizer; GA. Organic Material; FIO. Soil Conditioner; FIO. Mulch; FIO. Asphalt Adhesive; FIO. Pesticide; FIO.

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.
- h. Asphalt Adhesive: Composition.
- i. Pesticide. EPA registration number and registered uses.

## SD-18 Records

Quantity Check; GA.

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; FIO.

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record; GA.

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide; FIO.

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

### 1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

### 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

#### 1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

##### 1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

##### 1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

##### 1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

#### 1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

#### 1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

#### 1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

#### 1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

### PART 2 PRODUCTS

#### 2.1 SEED

##### 2.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

##### 2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be as specified in NJSSCL.

##### 2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be in accordance with NJSSCC.

##### 2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

##### 2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

##### 2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

#### 2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268 and NJSSCC. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

#### 2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

#### 2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

##### 2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To raise soil pH, ground limestone shall be used.

##### 2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

##### 2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

#### 2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

##### 2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

#### 2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

##### 2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

##### 2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

##### 2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

#### 2.3.4.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 3/8 inch screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 2 inches in length.

#### 2.3.4.5 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

#### 2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

##### 2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

##### 2.3.5.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrile, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

##### 2.3.5.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

##### 2.3.5.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

##### 2.3.5.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

## 2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

### 2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

### 2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

### 2.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

### 2.4.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

## 2.5 ASPHALT ADHESIVE

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

## 2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

## 2.7 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

## 2.8 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

### 2.8.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

### 2.8.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

### 2.8.3 Erosion Control Geomatrix

A semi-rigid, three dimensional geomatrix shall be provided for erosion control on earth-covered magazines. Material shall be a non-woven polyester fabric with a cell height of 4 inches and a minimum cell area of 200 square inches. Cells shall be backfilled with NJDOT No. 1 stone. Installation shall follow manufacturer's recommendations.

### 2.8.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

### 2.8.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

### 2.8.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLING SEED TIME AND CONDITIONS

#### 3.1.1 Seeding Time

Seed shall be installed from Feb. 15 to May 1 for spring establishment; and from Aug. 15 to Oct. 15 for fall establishment.

#### 3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

#### 3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

#### 3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

### 3.2 SITE PREPARATION

### 3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the seeding operation.

### 3.2.2 Application of Soil Amendments

#### 3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage operation.

#### 3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage or hydroseeding operation.

#### 3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 1 inch depth and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

#### 3.2.2.4 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

### 3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 4 inch depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

### 3.2.4 Prepared Surface

#### 3.2.4.1 Preparation

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

#### 3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 5/8 inch in any dimension shall be removed from the surface.

#### 3.2.4.3 Field Area Debris

Debris and stones over a minimum 3 inch in any dimension shall be removed

from the surface.

#### 3.2.4.4 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

### 3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

#### 3.3.1 Installing Seed

Seeding method shall be broadcast seeding, drill seeding or hydroseeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

##### 3.3.1.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 2.1 pounds per 1000 square feet using broadcast seeders. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device.

##### 3.3.1.2 Drill Seeding

Seed shall be uniformly drilled to a maximum 1/2 inch depth and at the rate of 2.1 pounds per 1000 square feet, using equipment having drills a maximum 7 inches distance apart. Row markers shall be used with the drill seeder. Half the total rate of seed application shall be drilled in 1 direction, with the remainder of the seed rate drilled at 90 degrees from the first direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations.

##### 3.3.1.3 Rolling

The entire area shall be firmed with a roller not exceeding 90 pounds per foot roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

#### 3.3.2 Hydroseeding

Seed shall be mixed to ensure broadcast at the rate of 2.1 pounds per 1000 square feet. Seed and fertilizer shall be added to water and thoroughly mixed to meet the rates specified. The time period for the seed to be held in the slurry shall be a maximum 24 hours. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

#### 3.3.3 Mulching

##### 3.3.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of

relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

#### 3.3.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

#### 3.3.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

#### 3.3.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

#### 3.3.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

#### 3.3.3.6 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

#### 3.3.4 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

### 3.4 SURFACE EROSION CONTROL

#### 3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

#### 3.4.2 Temporary Seeding

The application rate shall be 9.0 pounds per 1000 square yards. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

#### 3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

#### 3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

### 3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

### 3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

#### 3.6.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

#### 3.6.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

### 3.7 RESTORATION AND CLEAN UP

#### 3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

#### 3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

### 3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area

shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

### 3.9 SEED ESTABLISHMENT PERIOD

#### 3.9.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of work under this contract and shall end 3 months after the last day of the seeding operation. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

#### 3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

##### 3.9.2.1 Lawn Area

A satisfactory stand of grass plants from the seeding operation for a lawn area shall be a minimum 20 grass plants per square foot. Bare spots shall be a maximum 6 inches square. The total bare spots shall be a maximum 2 percent of the total seeded area.

#### 3.9.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

##### 3.9.3.1 Mowing

- a. Lawn Areas: Lawn areas shall be mowed to a minimum 3 inch height when the turf is a maximum 4 inches high. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

##### 3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 1/2 pound per 1000 square feet of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

##### 3.9.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

##### 3.9.3.4 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

##### 3.9.3.5 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance

work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

## SECTION 03250

## EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1982; R 1988) Basic Hardboard

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2628 (1991) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D 2835 (1989; R 1993) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

## FEDERAL SPECIFICATIONS (FS)

FS SS-S-1401 (Rev C; Am 1; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300SUBMITTAL PROCEDURES:

SD-01 Data

Materials; FIO.

Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

SD-13 Certificates

Materials; FIO.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

### 1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

## PART 2 PRODUCTS

### 2.1 CONTRACTION-JOINT STRIPS

Contraction-joint strips shall be 1/8 inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

### 2.2 EXPANSION-JOINT FILLER

Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed.

### 2.3 JOINT SEALANT

Joint sealant shall conform to the following:

#### 2.3.1 Preformed Polychloroprene Elastomeric Joint Seals

ASTM D 2628.

#### 2.3.2 Lubricant for Installation of Preformed Compression Seals

ASTM D 2835.

#### 2.3.3 Hot-Poured Type

FS SS-S-1401.

## PART 3 EXECUTION

### 3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

#### 3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC insert strips into the plastic concrete or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab approximately one-fourth the slab thickness but not less than 1 inch.

##### 3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of

the strips is maintained during insertion.

#### 3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete-sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

#### 3.1.2 Expansion Joints

Premolded expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4 inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

#### 3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Types and locations of sealants shall be as indicated. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant. Joints sealed with field molded sealant shall be completely filled with sealant.

-- End of Section --

## SECTION 03300

## CONCRETE FOR BUILDING CONSTRUCTION

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1981; Rev 1985) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1984; Rev 1988) Structural Concrete for Buildings
ACI 305R	(1989) Hot Weather Concreting
ACI 318	(1989) Building Code Requirements for Reinforced Concrete
ACI 347	(1988) Concrete Formwork

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1982; R 1988) Basic Hardboard
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615	(1989) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	(1988) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1986) Concrete Aggregates
ASTM C 39	(1986) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1987) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	(1984) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94	(1989b) Ready-Mixed Concrete
ASTM C 143	(1989a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1989) Portland Cement

ASTM C 171 (1969; R 1986) Sheet Materials for Curing Concrete

ASTM C 172 (1982) Sampling Freshly Mixed Concrete

ASTM C 173 (1978) Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C 192 (1988) Making and Curing Concrete Test Specimens in the Laboratory

ASTM C 231 (1989a) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260 (1986) Air-Entraining Admixtures for Concrete

ASTM C 309 (1989) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 330 (1987) Lightweight Aggregates for Structural Concrete

ASTM C 494 (1986) Chemical Admixtures for Concrete

ASTM C 597 (1983) Pulse Velocity Through Concrete

ASTM C 618 (1989) Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

ASTM C 803 (1982; R 1989) Penetration Resistance of Hardened Concrete

ASTM C 805 (1985) Rebound Number of Hardened Concrete

ASTM C 1017 (1985) Chemical Admixtures for Use in Producing Flowing Concrete

ASTM D 1751 (1983) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM E 96 (1990) Water Vapor Transmission of Materials

## CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI DA4 (1990; 25th Ed) Manual of Standard Practice

## DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1983) Construction and Industrial Plywood

## FEDERAL SPECIFICATIONS (FS)

FS CCC-C-467	(Rev C) Cloth, Burlap, Jute (or Kenaf)
FS SS-S-1401	(Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

## NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA-01	(Jan 1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready-Mixed Concrete Production Facilities
NRMCA CPMB-100	(Jan 1986) Concrete Plant Standards
NRMCA TMMB-1	(Jan 1982; 11th Rev) Truck Mixer and Agitator Standards

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## SD-04 Drawings

Concrete Reinforcement System; GA

Detail drawings showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

## SD-08 Statements

Proportions of Mix; FIO.

The results of trial mix along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory.

## SD-09 Reports

Sampling and Testing; FIO.

Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, cement, pozzolan, joint sealant, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials.

## SD-13 Certificates

Cementitious Materials; FIO.

Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.  
Reinforcing Steel; FIO

Certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.

1.4 GENERAL REQUIREMENTS

1.4.1 Strength Requirements

Structural concrete for all work except slabs on-grade shall have a 28-day compressive strength of 4000 pounds per square inch. Concrete slabs on-grade shall have a 28-day flexural strength of 600 pounds per square inch. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement.

1.4.2 Air Entrainment

Concrete exposed to freeze-thaw cycles shall contain from 5 to 7 percent total air. Other concrete may, at the option of the Contractor, be air entrained to produce concrete with 3 to 5 percent total air.

1.4.3 Special Properties

Concrete may contain other admixtures, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if approved.

1.4.4 Slump

Slump shall be within the following limits:

<u>Structural Element</u>	<u>Slump in inches</u>	
	<u>Minimum</u>	<u>Maximum</u>
Blast and Fragment Resistant Walls	4	6
Foundation walls, substructure walls, footings, pavement, and slabs	1	3
Any structural concrete approved for placement by pumping	None	6

\*Where use of superplasticizers are approved to produce flowing concrete these slump requirements do not apply.

1.5 PROPORTIONS OF MIX

1.5.1 Mixture Proportioning

Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of

concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength.

1.5.2 Average Strength

In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

1.5.2.1 Test Records Exceeding 29

Required average compressive strength used as the basis for selection of concrete proportions shall be the larger of the specified strength plus the standard deviation multiplied by 1.34 or the specified strength plus the standard deviation multiplied by 2.33 minus 500.

1.5.2.2 Test Records Less Than 29

Where a concrete production facility does not have test records meeting the above requirements but does have a record based on 15 to 29 consecutive tests, a standard deviation may be established as the product of the calculated standard deviation and a modification factor from the following table:

No. of tests (1)	Modification factor for standard deviation
less than 15	See Note
15	1.16
20	1.08
25	1.03
30 or more	1.00

(1) Interpolate for intermediate numbers of tests.

When a concrete production facility does not have field strength test records for calculation of standard deviation or the number of tests is less than 15, the required average strength shall be:

- a. The specified strength plus 1000 specified strength of less than 3000 psi.
- b. The specified strength plus 1200 for specified strengths of 3000 to 5000 psi.

c. The specified strength plus 1400 for specified strengths greater than 5000 psi.

#### 1.6 STORAGE OF MATERIALS

Cement and pozzolan shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

#### 1.7 FORM DESIGN

Formwork shall be designed in accordance with methodology of ACI 347 for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

### PART 2 PRODUCTS

#### 2.1 ADMIXTURES

Admixtures shall conform to the following:

##### 2.1.1 Accelerating Admixture

ASTM C 494, Type C or E.

##### 2.1.2 Air-Entraining Admixture

ASTM C 260.

##### 2.1.3 Flowing Concrete Admixture

ASTM C 1017, Type 1 or 2.

##### 2.1.4 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D.

#### 2.2 CEMENTITIOUS MATERIALS

Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:

##### 2.2.1 Cement

ASTM C 150, Type I or II or III.

### 2.2.2 Pozzolan

ASTM C 618, Class N. When a pozzolan is used in a flexural strength concrete mix design, the solid volume of pozzolan when combined with portland cement shall not exceed 25 percent of the solid volume of portland cement plus pozzolan.

## 2.3 AGGREGATES

Aggregates shall conform to ASTM C 33. Maximum size of coarse aggregate shall be 1/2 inch for Blast and Fragment Resistant Walls and No. 57 for all other work.

## 2.4 CURING MATERIALS

### 2.4.1 Burlap

FS CCC-C-467.

### 2.4.2 Impervious Sheets

ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

### 2.4.3 Membrane-Forming Compounds

ASTM C 309, Type 1-D, Class A or B.

## 2.5 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application.

## 2.6 FORM MATERIALS

### 2.6.1 Forms For Class B Finish

Forms for Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

### 2.6.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used.

### 2.6.3 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. That portion of the tie remaining permanently in the concrete shall not project beyond the surface of the concrete and shall be at least 1 inch back from any concrete surface that will be exposed or dampproofed. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch

nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall not be more than 1-1/2 inches in diameter.

#### 2.6.4 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

#### 2.7 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615 Grade 60, sizes as indicated.

#### 2.8 WIRE TIES

Wire ties shall be 16-gauge or heavier black annealed steel wire.

#### 2.9 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI DA4 and shall be precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks.

#### 2.10 CONTRACTION-JOINT STRIPS

Contraction-joint strips shall be 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1.

#### 2.11 EXPANSION-JOINT FILLER

Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8-inch thick and of a width applicable for the joint formed.

#### 2.12 JOINT SEALANT

Joint sealant shall be hot-poured type conforming to FS SS-S 1401.

#### 2.13 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96.

#### 2.14 WATER

Water shall be potable. Water for curing shall not contain any substance injurious to concrete, or which causes staining.

#### 2.15 DOWELS

Dowels shall conform to ASTM A 675, Grade 80, or ASTM A 499. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

#### 2.16 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184.

#### 2.17 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185 or ASTM A 497.

#### 2.18 NONSHRINK GROUT

Nonshrink grout shall conform to <RID>ASTM C 1107</RID> Grade A and shall be a formulation suitable for the application.

#### 2.19 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of fifty-five percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogenous material sufficiently porous to provide a good bond with portland paste; or factory-graded emery material consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The material shall be well graded from particles retained on the <MET>0.600 mm</MET> <ENG>No. 30</ENG> sieve to particles passing the <MET>2.36 mm</MET> <ENG>No. 8</ENG> sieve.

#### 2.20 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluoride can be used individually or in combination. Proprietary hardeners may be used if approved by the contracting officer.

#### 2.21 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to <RID>ASTM C 578</RID>, Type II; polyurethane conforming to <RID>ASTM C 591</RID>, Type II and having a minimum recovered material content of 9 percent by weight of core material in the polyurethane portion; or cellular glass conforming to <RID>ASTM C 552</RID>, Type I or IV. Polyurethane insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not involving material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided.

#### 2.22 INSULATED CONCRETE SANDWICH WALLS

Concrete sandwich wall panels shall be constructed as one unit, consisting of thermomass brand PC or CIP Fiber Composite Connectors which will hold the specially fabricated insulation, with an R-value of 5 per inch at 72 deg. F, in place and also connect the two 4-inch layers of concrete together such that they act as a composite panel.

The connectors shall have a tensile strength of 120 ksi, and a thermal conductivity of 2.1 BTU per sq. ft./hr./deg. F/in. The connection system shall not reduce the thermal resistance of the wall assembly by more than 2%. The system shall be in accordance with the thermal bridging provisions of <RID>ASHRAE 90.1</RID> and <RID>ASHRAE 90.2</RID>.</TXT>••</SPT =2.10>

### PART 3 EXECUTION

#### 3.1 PREPARATION OF SURFACES

Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.

##### 3.1.1 Foundations

Earthwork shall be as specified in Section 02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but without free water when concrete is placed. Semiporous subgrades for foundations and footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.

##### 3.1.2 Vapor Barrier

Subgrades for slabs in buildings shall be covered with a vapor barrier. Vapor barrier edges shall be lapped at least 4 inches and ends shall be lapped not less than 6 inches. Patches and lapped joints shall be sealed with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane.

##### 3.1.3 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

#### 3.2 FORMWORK

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified and conforming to construction tolerance given in TABLE 1. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

#### 3.3 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

#### 3.4 COATING OF FORMS

Forms for exposed surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written

instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.5 REMOVAL OF FORMS

Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Formwork for parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed until the structural units are strong enough to carry their own weight and any other construction or natural loads. In no case will supporting forms or shores be removed before the concrete strength has reached 70 percent of design strengths as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 10 feet of length ---- 1/4 inch Maximum for entire length --- 1 inch
2. Variation from the level or from the grades indicated on the drawings:	In any 10 feet of length ---- 1/4 inch In any 20 feet of length ---- 3/8 inch
a. In slab soffits and ceilings, measured before removal of supporting shores	Maximum for entire length --- 3/4 inch
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ----- 1/4 inch Maximum for entire length --- 1/2 inch
3. Variation of the linear building lines from established position in plan	In any 20 feet ----- 1/2 inch Maximum ----- 1 inch
4. Variation of distance between walls	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total

variation

- |              |   |  |
|--------------|---|--|
| 5.           | Variation in the sizes and locations of wall openings | Minus ----- 1/4 inch<br>Plus ----- 1/2 inch  |
| 6.           | Variation in the thickness of slabs and walls         | Minus ----- 1/4 inch<br>Plus ----- 1/2 inch  |
| 7. Footings: |   |  |
| a.           | Variation of dimensions in plan                       | Minus ----- 1/2 inch<br>Plus ----- 2 inches<br>when formed or plus 3 inches when<br><br>placed against unformed excavation |
| b.           | Misplacement of eccentricity                          | 2 percent of the footing width in the direction of misplacement but not more than ----- 2 inches                           |
| c.           | Reduction in thickness                                | Minus ----- 5 percent<br>of specified thickness  |

3.6 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.

3.6.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.6.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches.

3.7 INSTALLATION OF EMBEDDED ITEMS

Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

### 3.8 BATCHING, MIXING AND TRANSPORTING CONCRETE

Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-01. Site-mixed concrete shall be mixed in accordance with ACI 301. On-site plant shall conform to the NRMCA CPMB-100.

#### 3.8.1 Admixtures

Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing. Concrete that shows evidence of total collapse or segregation caused by the use of admixture shall be removed from the site.

#### 3.8.2 Control of Mixing Water

No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch except when on arrival at the jobsite, the slump of the concrete is less than that specified. Water added to bring the slump within the specified range shall not change the total water in the concrete to a point that the approved water-cement ratio is exceeded. The drum shall be turned an additional 30 revolutions, or more, if necessary, until the added water is uniformly mixed into the concrete. Water shall not be added to the batch at any later time.

### 3.9 SAMPLING AND TESTING

Sampling and Testing is the responsibility of the Contractor and shall be performed by an approved testing agency.

#### 3.9.1 Aggregates

Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C 33. Lightweight aggregate shall be sampled and tested in accordance with ASTM C 330. Gradation tests shall be performed on the first day and every other day thereafter during concrete construction.

#### 3.9.2 Sampling of Concrete

Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.

##### 3.9.2.1 Air Content

Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test per day shall be conducted.

##### 3.9.2.2 Slump

At least 2 slump tests shall be made on randomly selected batches of each mixture of concrete during each day's concrete placement. Tests shall be performed in accordance with ASTM C 143.

### 3.9.3 Evaluation and Acceptance of Concrete

#### 3.9.3.1 Frequency of Testing

Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent.

#### 3.9.3.2 Testing Procedures

Cylinders and beams for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39 and beams shall be tested in accordance with ASTM C 78. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days unless otherwise specified or approved.

#### 3.9.3.3 Evaluation of Results

Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch. For flexural strength concrete, the strength level of the concrete will be considered satisfactory if the averages of all sets of five consecutive strength test results equal or exceed the required flexural strength, and not more than 20 percent of the strength test results fall below the required strength by more than 100 pounds per square inch.

#### 3.9.4 Investigation of Low-Strength Test Results

When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by the Contracting Officer to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used a basis for acceptance or rejection. When strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by the Contracting Officer to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete

in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by the Contracting Officer, at the expense of the Contractor.

### 3.10 CONVEYING CONCRETE

Concrete shall be conveyed from mixer to forms as rapidly as possible and within the time interval specified in paragraph "CONCRETE PLACEMENT" by methods which will prevent segregation or loss of ingredients.

#### 3.10.1 Chutes

When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.

#### 3.10.2 Buckets

Bucket design shall be such that concrete of the required slump can be readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.

#### 3.10.3 Belt Conveyors

Belt conveyors may be used when approved. Belt conveyors shall be designed for conveying concrete and shall be operated to assure a uniform flow of concrete to the final place of deposit without segregation or loss of mortar. Conveyors shall be provided with positive means for preventing segregation of the concrete at transfer points and point of placement.

#### 3.10.4 Pumps

Concrete may be conveyed by positive displacement pumps when approved. The concrete shall be designed for pumping. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

### 3.11 CONCRETE PLACEMENT

Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by the Government if the concrete is of such slump after the 1-1/2

hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.

#### 3.11.1 Placing Operation

Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 8 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

#### 3.11.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for Blast and Fragment Resistant Walls and slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. Concrete in Blast and Fragment Resistant Walls shall be consolidated by placing manual vibration bars on the outside of the walls or by tapping with a rubber mallet. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

#### 3.11.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, chemical admixture conforming to ASTM C 494 Type C or E may be used.

#### 3.11.4 Warm Weather Requirements

The temperature of the concrete placed during warm weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

#### 3.12 CONSTRUCTION JOINTS

Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer except horizontal construction joints shall not be used in Blast and Fragment Resistant walls. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete walls shall be in place at least 2 hours, or until the concrete is no longer plastic, before placing concrete for slabs thereon. In walls having door openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph "PREPARATIONS OF SURFACES."

#### 3.13 FINISHING CONCRETE

##### 3.13.1 Formed Surfaces

Exposed surfaces shall have a Class B finish, and all other surfaces shall have a Class D finish.

##### 3.13.1.1 Repair of Surface Defects

Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by the Contracting Officer and finished slightly higher than the surrounding surface. For Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry-packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during

the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed.

#### 3.13.1.2 Class B Finish

Class B finish shall be provided for permanently exposed surfaces. All fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained through the use of Grade B-B plywood forms.

#### 3.13.1.3 Class C Finish

Class C finish shall be provided for surfaces that are not permanently exposed. All fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.

#### 3.13.2 Unformed Surfaces

In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 1/8 inch when tested with a 10-foot straightedge. Surfaces shall be pitched as indicated.

##### 3.13.2.1 Rough-Slab Finish

Slabs shall be screeded with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.

##### 3.13.2.2 Float Finish

Floor and roof slabs shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated.

##### 3.13.2.3 Trowel Finish

Slabs inside the magazine shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand.

##### 3.13.2.4 Broom Finish

After floating, exterior slabs on grade shall be lightly trowelled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

### 3.14 CURING AND PROTECTION

#### 3.14.1 General

All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type I or Type II cement	7 days
Concrete with Type I or Type II cement blended with pozzolan	7 days

Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.

#### 3.14.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap or saturated burlap.

#### 3.14.3 Membrane Curing

Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period. Surfaces coated with curing

compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

### 3.15 WELDED-WIRE FABRIC

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost cross wires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

### 3.16 DOWELS

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

### 3.17 PERIMETER INSULATION

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls.

#### 3.17.1 Insulated Concrete Sandwich Walls

Sandwich panel connectors and installation instructions shall be furnished by Composite Technologies Corporation, Amex, Iowa at 1-800-232-1748.

### 3.18 FLOOR HARDENER

Floor hardener shall be applied after the concrete had been air dried for 28 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, one pound of the silicofluoride shall be dissolved in one gallon of water. For subsequent applications, the solution shall be two pounds of silicofluoride to each gallon of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

-- End of Section --

## SECTION 03420

PLANT - PRECAST STRUCTURAL  
(CONTRACTOR'S OPTION)

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)  
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

ASTM A C150 or AASHTO	(1991) Portland Cement
ASTM C283	(1991) Low and intermediate tensile strength, carbon steel plates, shapes and bars
ASTM A 615	(1991) Deformed and plain billet steel bars for concrete reinforcement
ASTM C39	(1990) Compressive strength of cylindrical concrete specimen
ASTM C31	(1990) Making and curing concrete test specimens in the field
AASHTO T27	(1991) Sieve analysis of fine and coarse aggregates
AASHTO T236	(1991) Direct shear test of soils under consolidated drained conditions
AASHTO T99	(1990) Moisture-density relations of soils using a 5.5 lb (2.5kg) rammer and a 12 (305mm) drop

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300 SUBMITTALS:

SD-04, Drawings

Spread Footings Layout and Details; GA

Drawings shall include dimensions and overall plan layouts of footings based on in-situ conditions. They shall also include the number, size, type, and locations of all reinforcing steel bars in the footings.

SD-13, Certificates

Steel Panels; FIO

Certificates of compliance stating that the steel components inside the TechSpan™ precast element and the element fabrication conform to the requirements specified.

SD-20, Construction Methods and Procedures

TechSpan™ Arch System; FIO

Technical description of the materials, equipment, methods, procedures, and construction sequence to be used in constructing the TechSpan arch system, Procedures shall generally conform to those provided by the patent holder.

#### 1.4 STORAGE

TechSpan precast elements shall be stored on wooden bearers out of contact with the ground with a slope of 1:100 along the precast element length to prevent accumulation of water.

### PART 2 PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURER

The Contractor shall make his own arrangements to purchase the materials covered by this section of the specifications including concrete arch segments, joint materials, impermeable geomembrane, and all necessary incidentals from The Reinforced Earth Company (RECO), 8614 Westwood Center Drive, Suite 1100, Vienna, Virginia 22182 (Phone: 703-821-1175). The TechSpan™ system is protected by the U.S. Patent Number 4,826,639, application number 5212.

#### 2.2 PRECAST CONCRETE ARCH SYSTEM

##### 2.2.1 Concrete Reinforcement

ASTM A615 with 60,000 psi minimum yield strength.

##### 2.2.2 Concrete

1. Cement shall be Types I, II, or III, 3.0-6.0% air entrainment, and shall conform to the requirements of ASTM C150-86.
2. Concrete shall have a compressive strength at 28 days in accordance with Section 2.2.9.
3. Retarding or accelerating agents, or any additive containing chloride shall not be used without approval of RECO.
4. Concrete cover on reinforcement shall be 1" (25mm) minimum, unless otherwise indicated on the drawings.

##### 2.2.3 Steel Plates:

Steel plates shall be fabricated from A-283 steel plate material and bent in accordance with the drawings. Headed anchors shall be Nelson stud anchors (or approved equal), and shall be of the size and quantity indicated on the drawings. Headed anchors shall be welded to the bent steel plates in

accordance with the anchor manufacturer's recommendations. Steel plates shall be placed in the arch form prior to casting the arch segments and securely held in the proper position during the casting operation.

2.2.4 Casting:

Place concrete in arch unit without interruption and consolidate by use of an approved vibrator, supplemented by such hand-tamping as may be necessary to force the concrete into the corners of the forms. Formation of stone pockets or cleavage planes shall be prevented. Clear form oil from the same manufacturer shall be used throughout the casting operation. Lifting devices shall be set in place to the dimensions and tolerances shown on the drawings prior to casting.

2.2.5 Curing

Cure precast arch segments for a sufficient length of time so that the concrete will develop the specified compressive strength. Any production lot which does not conform to the strength requirements of Section 2.2.9 shall be rejected.

2.2.6 Removal of Forms

Maintain forms in place until concrete has cured to a suitable strength that will allow elements to be safely removed without damage.

2.2.7 Concrete Finish

The inside face of all arch elements shall have a smooth gray consistent finish. Consistency of finish shall be maintained with the use of the same concrete mix and same type of form oil for the entire project. The side edge(s) of the element shall have an unformed surface finish, trowelled with no open pockets or distortions in excess of 3/16" (5mm).

2.2.8 Allowable Tolerances

Manufacture all units within the following tolerances:

Chords and Diagonals

Dim. > than or = to		Arch Segment Tolerance	Average Lot tolerance
> than or = to	and < than		
0 ft	15.75 ft	± 3/16" (5mm)	± 3/16" (5mm)
15.75 ft (4.8m)	31.5 ft	±5/16" (8mm)	± 3/16" (5mm)
31.5 ft (9.6m)	47.25 ft	±1/2" (12mm)	± 1/4" (6mm)
47.25' (14.4m)	Larger	±3/4" (20mm)	± 3/8" (10mm)

1. TechSpan Element Width : +3/16" to -3/16" (+ 5mm to -5mm)
2. TechSpan Element Thickness: +9/16" to -3/16" (15mm to -5mm)
3. Arch Surface Finish: Surface defects on smooth formed surfaces of the precast arch section measured with a straight edge over a 4 ft (200mm) length shall not exceed 3/16" (5mm).
4. The average lot tolerance shall be rendered as an overall quality control check for comparison of arch segments cast within the same project.

### 2.2.9 Compressive Strength

1. Acceptance of the precast concrete arch elements, with respect to compressive strength, will be determined on the basis of production lots.
  - a. A production lot is defined as a group of precast concrete arch segments that will be represented by a single compressive strength sample and will consist of either eight arch elements or a single day's production, whichever is less.
2. During production of the precast concrete arch segments, the manufacturer will randomly sample the concrete in accordance with AASHTO T-141.
  - a. A single compressive strength sample, consisting of a minimum of four cylinders, will be randomly selected for every production lot.
3. Cylinders for compressive strength testing shall be prepared in accordance with ASTM C31 (Dimensions: 2 x Diameter = Height). For every compressive strength sample, a minimum of two cylinders shall be cured in the same manner as the arch segments and tested at approximately seven (7) days. The average compressive strength of these cylinders, when tested in accordance with ASTM C39, will provide a test result which will determine the initial strength of the concrete. In addition, two cylinders shall be cured in accord with ASTM C31 and tested at 28 days. The average compressive strength of these two cylinders, when tested in accordance with ASTM C39, will provide a compressive strength test result which will determine the compressive strength of the production lot.
4. If the initial strength test result indicates a compressive strength in excess of 4,000 psi (27.6 MPa), then that initial test result may be considered the compressive strength test for that production lot, and the requirement for further testing at 28 days may be waived for that same production lot. [Note: It may still be desirable to perform strength tests at 28 days to meet the requirements of production lot acceptance under Item 5]
5. Acceptance of a production lot will be made if the compressive strength test results is equal to or greater than 4000 psi (27.6 MPa). If the compressive strength test result is less than 4,000 (27.6 MPa) psi, the acceptance of the production lot will be based upon its meeting the following acceptance criteria in its entirety:
  - a. 90% percent of the compressive strength test result for all production lots shall exceed 4,150 psi (28.6 MPa).
  - b. The average of any six consecutive compressive strength test result shall exceed 4,250 psi (29.3 MPa).
  - c. No individual compressive strength test result shall fall below 3,600 psi (24.8 MPa).
6. In the event a production lot fails to meet the specified compressive strength requirements, the elements from the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at his own expense, obtains and submits evidence of a type acceptable to the Owner's Engineer that the strength and quality of the concrete placed within the elements of the production lot is acceptable.

- a. If such evidence consists of tests made on cores taken from the precast concrete arch segments within the production lot, the cores shall be obtained and tested in accordance with AASHTO T-24.

#### 2.2.10 Repairs at Fabrication Facility

1. It is recognized that certain cracks and surface defects may not be detrimental to the structural integrity of the arch unit and may be harmless if remedied by proper repair.
2. Before shipment, surfaces of all precast arch units shall be examined. The RECO Project Manager (PM) will determine the kind, type and extent of cracks and surface defects, such as honeycomb and chipped edges or corners that may be repaired. All such cracks and surface defects shall be repaired in a manner satisfactory to the PM.
3. If the PM determines that defective concrete unit(s) cannot be repaired properly and satisfactorily, the unit(s) shall be rejected.

#### 2.2.11 Marking

The date of manufacture, the production lot number, and the piece-mark shall be clearly inscribed on the unformed edge of each arch segment.

#### 2.2.12 Handling, Storage and Shipping

Handle, store and ship units in such a manner as to eliminate the danger of chipping, cracking, and excessive bending stresses. Precast concrete arch segments in storage shall be properly placed on edge on firm blocking on level ground to avoid damage or warping.

### 2.3 IMPERMEABLE GEOMEMBRANE

Impermeable geomembrane shall be Bituthene 3000 membrane as manufactured by the W.R. Grace Company or equal as approved by The Reinforced Earth Company.

### 2.4 FLOWABLE GROUT

High fluidity, non-ferrous, non-shrink grout as manufactured by the Burke Company or approved equal by The Reinforced Earth Company, shall be used after erection to grout the TechSpan elements into the keyway or recess in the cast-in-place footing. Grout shall have a compressive strength of at least 4,000 psi and shall meet Corps of Engineers CRD-C621-88 for all consistencies.

### 2.5 BACKFILL

#### 2.5.1 Select Granular Backfill

All select granular backfill material used around the TechSpan precast arch system in Zones 1 and 2, as indicated on the drawings, shall be free from organic or otherwise deleterious materials. In addition, the select granular backfill material shall conform to the following requirements:

1. The backfill material shall conform to the following gradation limits in accordance with AASHTO T-27.

Sieve Size

Percent Passing

3 inches (76mm)	100
3/4 inches (19 mm)	20-100
No. 40 (0.425 mm)	0-60
No.200 (0.075 mm)	0-15

2. The material shall exhibit an angle of internal friction of not less than 34 degrees as determined by the standard direct shear test - AASHTO T-236, utilizing a sample of the material compacted to 95 percent of AASHTO T-99 Methods C or D (with oversize correction as outlined in Note 7) at optimum moisture content.
3. The material shall be substantially free of shale or other soft or poor durability particles. The material shall exhibit magnesium sulfate soundness loss of less than 30 percent after four (4) cycles in accordance with AASHTO T-104.
4. Backfill not conforming to these specifications shall not be used without the written consent of RECO.
5. The Contractor shall provide the Owner's Engineer with a certificate of compliance certifying that the select granular backfill material complies with this section of the specifications. A copy of all test results performed by the contractor, which are necessary to assure compliance with the specification, shall also be furnished to the Owner's Engineer.
6. The frequency of sampling of select granular backfill, necessary to assure gradation control throughout construction, shall be as directed by the Owner's Engineer.

2.5.2 Embankment Fill Material

Embankment fill (Zone 3) used outside of the select granular backfill volume (Zones 1 and 2) shall exhibit an angle of internal friction of not less than 30 degrees. Embankment fill not conforming to this requirement shall not be used without the written consent of RECO.

PART 3 EXECUTION

3.1 GENERAL

The precast concrete arch structure shall be constructed in accordance with the lines, grades, details and dimensions shown on the drawings. The Contractor shall make use of the technical assistance provided by the supplier and provide adequate notice to the supplier of the date for start of arch erection.

3.2 PRECAST CONCRETE ARCH SEGMENT

3.2.1 Off-loading, handling, storage, and pre-assembly

When precast concrete arch segments (or elements) are off-loaded and stored, they shall be placed on edge upon secured dunnage on a level surface to avoid damage and warping, and to maintain cleanliness of the element prior to erection.

3.2.2 Erection of Precast Concrete Arch Segments:

1. Precast concrete segments shall be handled with a crane with a suitable capacity to safely handle the arch elements. TechSpan elements shall be lifted using inserts placed in the elements for that purpose.
2. Erect elements in sequence as shown on the drawings. When foundation is sloped, erection should begin at the low end of the structure and proceed in the up-slope direction.
3. Place segments tight against the front edge of the "recess" in the cast-in-place footing with the aid of wedging from the back of the segments. Longitudinally, joints between adjacent segments shall not exceed 3/4" (19 mm). The edge of the element on one side of the arch structure shall be placed to within 3/8" (10mm) from the centerline of the last element placed on the opposite side. Adjust element locations longitudinally to achieve consistent joint spacing.
4. Secure connecting wires between adjacent elements progressively as the placement of the arch segments advances. Place impermeable membrane over the joints using adhesive.
5. The final position of the installed arch segments shall clear both horizontally and vertically the span and height requirements of the tunnel.

### 3.3 GROUTING

Grout the TechSpan elements into the cast-in-place footing keyway recess after the arch is completely installed (on both sides) but prior to backfilling. Grout shall be cured in a manner sufficient to achieve specified strength.

### 3.4 CROWN BEAM

#### 3.4.1 Concrete for the Cast-in-Place Crown Beam

Concrete for the cast-in-place crown beam shall have a minimum 28 day compressive strength of 4,000 psi (27.6 MPa).

#### 3.4.2 Steel Reinforcing Bars

Steel reinforcing bars shall be ASTM A615, 60,000 psi (414 MPa) minimum yield strength.

#### 3.4.3 Cast-in-Place Crown Beam

The cast-in-place crown beam shall be formed to the dimensions shown in the drawings when granular backfill has reached the top of the assembled arch units.

#### 3.4.4 Styrofoam Spacers

Styrofoam spacers shall be incorporated into the crown beam as indicated by the drawings.

#### 3.4.5 Construction Joints

Construction joints in the cast-in-place crown beam shall be approved by the Engineer.

3.5 BACKFILL PLACEMENT

3.5.1 Commencing Backfilling

Do not commence backfilling until grouting of the footing keyway recess has been completed and cured as specified. In addition, backfill shall not proceed above the top of arch until casting of the crown beam has been completed and cured as specified.

3.5.2 Backfilling of TechSpan Structures

Backfilling of TechSpan structures must be performed in coordination with the erection and backfilling of the collar wall and wing walls as indicated on the drawings.

3.5.3 Placment of Backfill

Place approved backfill material in maximum 10"(250mm) compacted lifts unless otherwise specified. At no time during backfilling of the TechSpan structure should the differential level between opposite sides of the TechSpan structure exceed 20"(500mm).

3.5.4 Compaction Zones

TechSpan structures require three compaction zones, as shown on the drawings and described in the following table.

ZONE	RANGE LOCATION	COMPACTION	EQUIP. TYPE
1	0.0 - 1.5 ft (0 - 450mm) measured from backface of TechSpan element.	None	None
2	1.5 ft - 3.0 ft (450 - 900 mm) measured from back face of TechSpan element.	95% Standard Proctor per AASHTO T-99	Light walk behind compactor
3	> 3.0 ft (1000 mm) horizontally from backface of TechSpan element at footing.  > 3.0 ft (1000 mm) vertically above crown of TechSpan	95% Standard Proctor per AASHTO T-99	Large drum roller (with vibration)

3.5.5 Grading

At the end of each day, the backfill must be graded or sloped away from the back of the TechSpan segment to divert any run-off away from the work area.

3.5.6 Heavy equipment

Trucks and heavy equipment should not come closer than 5 ft (1500 mm) of the concrete TechSpan segments during any stage of backfilling, and must not traverse the longitudinal axis of the structure until a minimum of 3 ft (1000 mm) of fill has been placed above the arch crown. A further determination of maintained distances from the arch structure shall be made

by the Contractor and Owner's Engineer on the basis of the type of trucks or other narrow wheel-based equipment planned for use during backfill operations.

PART 4 (NOT USED)

-- End of Section --

## SECTION 04200

## MASONRY

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONCRETE INSTITUTE (ACI)

ACI SP-66 (1988) ACI Detailing Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1990a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153 (1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615 (1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 55 (1993a) Concrete Building Brick

ASTM C 90 (1993) Load-Bearing Concrete Masonry Units

ASTM C 91 (1993) Masonry Cement

ASTM C 270 (1992a) Mortar for Unit Masonry

ASTM C 476 (1991) Grout for Masonry

ASTM C 641 (1982; R 1991) Staining Materials in Lightweight Concrete Aggregates

ASTM C 780 (1991) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1072 (1993) Measurement of Masonry Flexural Bond Strength

ASTM D 2000 (1990) Rubber Products in Automotive Applications

ASTM D 2240 (1991) Rubber Property - Durometer Hardness

ASTM D 2287 (1992) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300SUBMITTAL PROCEDURES:

SD-01 Data

Concrete Brick; GA. Insulation; GA.

Manufacturer's descriptive data.

SD-04 Drawings

Masonry Work; GA.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-08 Statements

Cold Weather Installation; GA.

Cold weather construction procedures.

SD-09 Reports

Efflorescence Test; GA. Field Testing of Mortar; GA. Field Testing of Grout; GA. Prism tests; GA. Masonry Cement; GA. Fire-rated CMU; GA.

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

SD-13 Certificates

Concrete Masonry Units (CMU); FIO. Control Joint Keys; FIO. Anchors, Ties, and Bar Positioners; FIO. Expansion-Joint Materials; FIO. Joint Reinforcement; FIO. Reinforcing Steel Bars and Rods; FIO. Masonry Cement; FIO. Insulation; FIO. Precast Concrete Items; FIO.

Certificates of compliance stating that the materials meet the specified requirements.

Insulation; GA

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-14 Samples

Concrete Masonry Units (CMU); GA. Concrete Brick; GA.

Anchors, Ties, and Bar Positioners; GA.

Two of each type used.

Expansion-Joint Material; GA.

One piece of each type used.

Joint Reinforcement; GA.

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation; GA.

One piece of board type insulation, not less than 16 inches by 24 inches in size, containing the label indicating the rated permeance and R-values.

### 1.3 NOT USED

### 1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

#### 1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite. In addition, glass block units and prefaced concrete units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

#### 1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

#### 1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

### 2.2 NOT USED

### 2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Type I, Grade N. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

### 2.4 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, Normal weight. Cement shall have a low alkali content and be of one brand.

#### 2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

#### 2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

#### 2.10 MORTAR

Mortar shall be Type N in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Evaluation of performance shall be based on ASTM C 780 and ASTM C 1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the No. 8 sieve and 95 percent passing the No. 16 sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

#### 2.11 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.11.1 NOT USED

##### 2.11.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

#### 2.12 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be

zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

#### 2.12.1 Wire Mesh Ties

Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.

#### 2.12.2 NOT USED

#### 2.12.3 NOT USED

#### 2.12.4 NOT USED

#### 2.12.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

### 2.13 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153, class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

### 2.14 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615, Grade 60.

### 2.15 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

### 2.16 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920 JOINT SEALING.

## PART 3 EXECUTION

## 3.1 ENVIRONMENTAL REQUIREMENTS

## 3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

## 3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

## 3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.
- b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.
- c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.
- d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

## 3.1.2.2 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.
- b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

- d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

### 3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be free from chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

#### 3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

#### 3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

#### 3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 NOT USED

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises

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In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines

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In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines

---

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls

---

In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines

---

In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of columns and in thickness of walls

---

Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the

work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

### 3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

#### 3.2.7.1 NOT USED

#### 3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

### 3.2.8 Joint Widths

Joint widths shall be as follows:

#### 3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

#### 3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

#### 3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Tothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

#### 3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

#### 3.2.12 Partitions

Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be otherwise may be stopped

approximately 4 inches above the ceiling level. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement.

Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections of partitions.

3.3 NOT USED

3.4 NOT USED

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.10 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.10.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.10.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.11 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be

placed to provide not less than 5/8 inch cover to either face of the unit.

### 3.12 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

#### 3.12.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

#### 3.12.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

#### 3.12.3 Grout Holes and Cleanouts

##### 3.12.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

##### 3.12.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

#### 3.12.4 Grouting Equipment

##### 3.12.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping,

waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

#### 3.12.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

#### 3.12.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

##### 3.12.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

##### 3.12.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall

between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

## POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

## Notes:

- (1) The actual grout space or cell dimension must be larger than the sum of the following items:
  - a) The required minimum dimensions of total clear areas given in the table above;
  - b) The width of any mortar projections within the space;
  - c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.
- (3) For grouting spaces between masonry wythes.
- (4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

## 3.13 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

## 3.14 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using special control-joint units or sash jamb units with control joint key

in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07920 JOINT SEALING. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.15 NOT USED

3.15 NOT USED

3.16 LINTELS

3.16.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.17 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.18 NOT USED

3.19 NOT USED

3.20 NOT USED

3.21 NOT USED

3.22 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.22.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.23 NOT USED

## 3.24 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

-- End of Section --

## SECTION 05310

## STEEL DECKS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673 1989 (Errata 1990) Cold-Formed Steel Design Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446/A 446M 1991 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 525 1991 (Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A 611 1992 Steel, Sheet, Carbon, Cold-Rolled, Structural Quality

## FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 1993 Approval Guide

FM D/S1-28 1991 Insulated Steel Deck

## STEEL DECK INSTITUTE (SDEI)

SDEI DMCDFDRD 1992 (Number 28) Design Manual for Composite Decks, Form Decks and Roof Decks

SDEI MCSD 1992 Manual of Construction with Steel Deck

## UNDERWRITERS LABORATORIES INC. (UL)

UL BMD 1992 Building Materials Directory

UL 580 1988 (R 1989) Uplift Resistance of Roof Assemblies

## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## 1.2.1 SD-02, Manufacturer's Catalog Data

a. Accessories G A/E

## 1.2.2 SD-04, Drawings

a. Layout G A/E

#### 1.2.2.1 Layout Drawings

Show location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, and other pertinent details.

#### 1.2.3 SD-05, Design Data

##### a. Deck units G A/E

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

#### 1.2.4 SD-13, Certificates

##### a. Wind storm resistance G A/E

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Steel Deck

Deck and accessories shall be products of a manufacturer regularly engaged in manufacture of steel decking.

#### 1.3.2 Regulatory Requirements

##### 1.3.2.1 Fire Safety

Roof deck shall have been tested as a part of a roof deck construction assembly of the type used for this project, shall be listed as fire classified in the UL BMD, or listed as Class I construction in the FM P7825, and so labeled.

##### 1.3.2.2 Wind Storm Resistance

The roof construction assembly shall be capable of withstanding an uplift pressure of 300 kgs per square meter when tested in accordance with the uplift pressure test described in the FM D/S1-28 or as described in UL 580.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage the material or overload the decking during the construction period. The maximum uniform distributed storage load shall not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide for drainage. Maintain deck finish at all times to prevent the formation of rust. Replace damaged material.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than 1.0 mm before coating, meeting the requirements of AISI SG-673, except as modified herein.

#### 2.1.2 Steel Coating

ASTM A 525 designation G90 galvanized. Apply coating to both sides of

sheet.

## 2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

### 2.2.1 Adjusting Plates

Provide adjusting plates of same thickness and configuration as decking. Provide factory cut plates of predetermined size where possible.

### 2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 1.0 mm to close open ends at end walls, eaves, and openings through deck.

### 2.2.3 Cover Plates

Sheet metal. Polyethylene-coated, self-adhesive, 50 mm wide joint tape may be provided in lieu of cover plates on flat-surfaced decking.

### 2.2.4 Access Hole Covers

Sheet metal, minimum 1.2 mm thick.

### 2.2.5 Miscellaneous Accessories

Provide cant strips, fasteners, and other types of plates and closures as indicated or as necessary to complete the work. Provide accessories required for a finished installation.

## 2.3 FABRICATION

### 2.3.1 Deck Units

SDEI DMCDFDRD. Form decking and accessories from ASTM A 446/A 446M coated steel sheets, Grade A (231 MPa minimum yield strength); ASTM A 611 coated carbon steel sheets, Grade C, (231 MPa minimum yield strength). Provide deck units having the depth and the minimum structural properties indicated.

### 2.3.2 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured. Provide shop primer compatible with field applied finish painting, as specified in Section 09900, "Paints and Coatings."

## PART 3 EXECUTION

### 3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

### 3.2 INSTALLATION

Install steel deck units in accordance with approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before

permanently anchoring deck units. Locate deck ends over supports only. Lap roof deck a minimum of 50 mm. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated.

### 3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units with screws and to adjacent deck units with Tec Screws. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing fastening. Anchoring the deck to structural supports with welds is prohibited. Attachment of adjacent deck units by button-punching is prohibited.

### 3.2.2 Openings

Reinforce deck or frame openings through deck as necessary for rigidity and load carrying capacity. Cut or drill holes or other openings required for work of other trades. Deck manufacturer shall approve holes or openings larger than 6 inches in diameter prior to drilling or cutting. Openings shall not interfere with seismic members such as chords and drag struts.

### 3.2.3 Deck Damage

SDEI MCSD, for repair of deck damage.

### 3.2.4 Accessory Installation

#### 3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

#### 3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

## 3.3 FIELD QUALITY CONTROL

### 3.3.1 Flatness

Inspect the decking top surface for flatness after installation. Verify flatness by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1.6 mm; when gap is more than 1.6 mm, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

## SECTION 05315

## BLAST AND FRAGMENT RESISTANT WALLS

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446	(1987) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 548	(1982) Steel Wire, Carbon, Cold-Heading Quality, for Tapping or Sheet Metal Screws
ASTM A 615	(1989) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement Textile

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300 SUBMITTALS:

SD-04, Drawings

BFR Wall Layout and Details; GA

Detail drawings shall include dimensions, required type, number, and length of all BFR steel panels, panel connection details, details at wall corners, and details for fabrication of all steel panels. Drawings shall include overall plan layouts and elevations of walls sufficient to show final panel arrangements. Drawings shall also include number, size, type, dimensions and locations of all additional reinforcing steel bars in the walls.

SD-13, Certificates

Steel Panels; FIO

Certificates of compliance stating that all steel facing panels, lacing panels, and miscellaneous steel components of the BFR walls conform to the requirements specified.

SD-20, Construction Methods and Procedures

BFR Wall System; FIO.

Technical description of the materials, equipment, methods, procedures, and construction sequence to be used in constructing the BRF walls, Procedures shall generally conform to those provided by the patent holder.

#### 1.4 STORAGE

BFR steel panels shall be stored on wooden bearers out of contact with the ground with a slope of 1:100 along the sheet length to prevent accumulation of water. The steel panels shall be covered with a waterproof cover to prevent exposure to water but allow air circulation.

### PART 2 PRODUCTS

#### 2.1 BLAST AND FRAGMENT RESISTANT (BFR) WALLS

The headwall, side and rear walls of this magazine shall be walls made from the Blast and Fragment Resistant (BFR) wall system. The BFR system is protected by United States Patent Number 4,433,522 and other patents. Walls shown on the drawings as 12 inches thick shall be made of the 300 millimeter thick BFR wall section. Walls shown on the drawings as 10 inches thick shall be made of the 250 millimeter thick BFR wall section.

#### 2.2 STEEL PANELS

Steel facing panels, lacing panels, half panels, and other miscellaneous panels for the BFR walls shall conform to ASTM A 446, Grade B, coating designation G90, non-oiled. Dimensions, gage, and corrugation pattern of these panels shall conform to the requirements of the BFR system as defined by the patent holder.

#### 2.3 CONCRETE

Concrete for infill in the BFR walls shall conform to Section 03300, CONCRETE FOR BUILDING CONSTRUCTION.

#### 2.4 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A 615, Grade 60.

#### 2.5 STEEL SHEET METAL SCREWS

Steel sheet metal screws shall be the self-tapping type, galvanized conforming to ASTM A 548.

### PART 3 EXECUTION

#### 3.1 GENERAL

BFR walls shall be constructed according to the methods and procedures generally outlined by the manufacturer and provided in the submittals.

#### 3.2 WORKMANSHIP

Workmanship and manufacturing tolerances of the BFR steel elements shall be such as to insure proper fit when assembled and interchangeability of elements of the same type and size. Panels shall be well formed to shape and size, with sharp lines and true curves. Panels with warped or buckled edges shall not be used in wall construction and shall be removed from the job site.

#### 3.3 PREPARATION OF MATERIALS

Before erection, all BFR steel elements shall be inspected and cleaned of all loose scale, rust, and other deleterious material. Any damage to the galvanized coating shall be repaired using a zinc-rich paint.

3.4 ERECTION OF STEEL PANELS

Erection of steel BFR panels shall not begin until foundations have been completed. Steel panels shall be erected in accordance with the manufacturer's recommended procedure. Steel panels shall be erected plumb and true to lines indicated on the drawings and in conformance with the tolerances listed in Table 1. Joints between steel panels shall be connected with no fewer than two steel sheet metal screws at each end and shall be mortar tight.

3.5 TEMPORARY BRACING

Temporary bracing shall be provided to prevent misalignment and damage to the erected BFR steel panels during construction and bulging and separating of the steel panels during concrete placement. Care shall be taken to prevent the bracing from damaging the galvanized coating on the steel panels. Bracing shall remain in place until the walls are strong enough to carry their own weight and any other construction or natural loads, but not before 24 hours has elapsed since concrete placement. Construction of the roof slab shall not be started until the walls are sufficiently strong to support the roof. In no case shall bracing be removed before the concrete strength has reached 70 percent of design strength as determined by field cured cylinders or other methods.

3.6 PLACING CONCRETE

Concrete shall be placed successively in lifts not exceeding 24 inches, and each lift shall be allowed to partially set before pouring the next lift. Concrete may be placed using buckets or chutes or by pumping. If concrete pumping is used, the rate of pumping shall not exceed 7-1/2 cubic yards per hour. The work shall be visually inspected during the placement of each lift to ensure that all spaces between the steel panels are completely filled with concrete.

3.7 CONSOLIDATION

Immediately after placing, each layer of concrete shall be consolidated. Consolidation shall be by placing manual vibration bars on the outside of walls or by tapping with a rubber mallet. Internal vibrators shall not be used for consolidation of concrete in BFR walls. The use of form vibrators must be specifically approved.

3.8 CONSTRUCTION JOINTS

Vertical construction joints shall be made using the manufacturer's recommended method. Vertical joints shall be located not less than 6 feet from wall corners. BFR steel facing panels shall be continuous across vertical construction joints. Horizontal construction joints shall not be permitted.

TOLERANCES FOR BFR WALLS

1.	Variations from the plumb	In any 10 feet of length ---- 1/4 inch Maximum for entire length --- 1 inch
2.	Variation from the level	In any 10 feet of length ---- 1/4 inch Maximum for entire length --- 3/4 inch
3.	Variation of the linear	In any 20 feet ----- 1/2 inch

building lines from established position in plan	Maximum -----	1 inch
4. Variation of distance between walls		1/4 inch per 10 feet of distance, but not more than 1 inch total variation
5. Variation in the sizes and locations of wall openings	Minus -----	1/4 inch
	Plus -----	1/2 inch
6. Variation in the thickness of walls	Minus -----	1/2 inch
	Plus -----	1/2 inch

-- End of Section --

## SECTION 05500

## MISCELLANEOUS METAL

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335 (1989) Specification of Structural Steel Buildings - Allowable Stress Design, Plastic Design

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1989) Structural Steel

ASTM A 53 (1989a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 325 (1986a) High-Strength Bolts for Structural Steel Joints

ASTM A 446 (1989) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 500 (1989) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 525 (1987) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1988) Structural Welding Code - Steel

## MILITARY SPECIFICATIONS (MS)

MIL-H-29181 (18 Aug 1978; Rev 21 Dec 1987) Hasp, High Security, Shrouded, for High and Medium Security Padlock

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## SD-02 Manufacturer's Catalog Data

Extruded rubber fenders.

## SD-04 Drawings

Miscellaneous Metal Items; GA.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings shall be submitted for the following items: Doors and Door Frames; Door Operators and Hardware; Louvers and Louver Fragment Shields; Ventilator; and Weatherstripping.

## SD-13 Certificates

Extruded rubber fender.

## 1.4 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 446, or ASTM A 525, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

## 1.5 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

## 1.6 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

## 1.7 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or

indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete.

## PART 2 PRODUCTS

### 2.1 STRUCTURAL STEEL

Structural steel shapes and plates shall conform to ASTM A 36 unless otherwise noted or specified.

### 2.2 BOLTS

Unless otherwise noted, structural steel bolts, including nuts and washers, shall conform to ASTM A 325.

### 2.3 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

### 2.4 MAGAZINE LOUVER GUARDS

Louver guards shall be 1/2-inch round bars, spaced not over 8 inches on center horizontally. Bars shall be securely welded to the angle frame. Guards and fasteners shall be galvanized.

### 2.5 NOT USED

### 2.6 NOT USED

### 2.7 MAGAZINE LOUVERS

Louvers shall be galvanized steel and the standard product of a manufacturer regularly engaged in the manufacture of louvers of the type shown, and the louvers provided shall essentially duplicate louvers that have been in successful operation for a period of at least 5 years. Louvers shall not be removable from the outside of the structure. Louvers shall be provided with 140 degrees F fusible link fire damper mechanism, equipped with suitable spring closing device, and 16 mesh insect screens. Blades shall be accurately fitted and edges of louver blades shall be folded or beaded for rigidity.

### 2.8 MAGAZINE VENTILATORS

Ventilators shall be of the stationary type, constructed of galvanized ferrous metal sheets, and shall be furnished complete, including insect screens. The ventilators shall be designed to withstand stresses developed by winds up to and including 125 miles per hour, shall be waterproof and stormproof under all operating conditions, and shall be free from backdraft. The design shall be such that the ventilators will be capable of self-cleaning by the action of the elements, with provision for carrying water and normal, wind-transported soil matter to the outside. Ventilators shall be adequately reinforced and will braced, with joints properly formed. Reinforcing members, braces, bolts, and rivets shall be of galvanized ferrous metal of sufficient size to assure rigid and sturdy construction, shall be properly applied and installed in such manner as to avoid corrosion, and shall be secured in an approved manner.

## 2.9 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

## 2.10 STEEL DOOR FRAMES

Steel door frames shall be made of structural steel conforming to ASTM A 36. Steel door frames shall be neatly mitered and securely welded at the corners with all welds ground smooth. Provision shall be made to stiffen the top member for all spans over 3 feet.

## 2.11 HIGH SECURITY HASPS

High security hasps shall conform to MIL-H-29181, Style NAPEC and 0957-2. High security hasps are Government-furnished, Contractor-installed items.

## 2.12 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

## 2.12 "D" SHAPE TYPE RUBBER FENDER

Impact type bumper cushions shall be extruded from EPDM rubber meeting or exceeding the following specifications:

Tensile Strength	200 PSI
Elongation	300 Percent
Hardness	70 plus or minus 5
Tear Strength	
(ASTM D 624)	225 lbs/in
Brittleness	Minus 64 degrees (no failure)
Ozone Resistance	
(ASTM D 1171)	Exposure method A or B.
Impact Resistance	
(ASTM D 2632)	Absorbs 75 percent of force
Deflection at 60,000 Ft. lbs.	3 inches with no ruptures

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Item listed below require additional procedures as specified.

### 3.2 PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in SECTION 03300 CONCRETE FOR BUILDING CONSTRUCTION.

-- End of Section --

## SECTION 05510

## COLD FORMED STEEL TRUSSES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 525	(1993) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM C 955	Standard Specification for Load Bearing (Transverse and Axial) Steel Studs, Runner (Track) and Bracing and Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases
ASTM C 1007	Standard Specification for the Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories

## AMERICAN IRON AND STEEL INSTITUTE PUBLICATION (AISI)

AISI Design Manual	Specification for the Design of Cold-Formed Steel Structural Members, 1980 Revision
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## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Cold Formed Steel Trusses; FIO

Manufacturer's descriptive data and technical literature.

Design Analysis; GA

Design analysis as one package with the drawings.

SD-04 Drawings

Cold Formed Steel Trusses; GA.

Detail drawings indicating truss member thickness, type, grade, and class; fastener type and quantity dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data, installation instructions, design and erection drawings.

#### SD-13 Certificates

Cold Formed Steel Trusses; FIO

Submit statements from the framing manufacturer certifying conformance with ASTM C 955.

### 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before installation. Trusses shall be hot-dip galvanized in accordance with ASTM A 525. Exposed fastenings shall be of compatible materials. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Products and installation shall, as a minimum, conform to ASTM C 955 and ASTM C 1007 and to the AISI Design Manual

### 1.4 DESIGN REQUIREMENTS

Criteria, loading combinations, and definitions shall be in accordance with ASCE 7.

#### 1.4.1 Dead Loads

The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.

#### 1.4.2 Collateral Loads

Collateral load of 5 pounds per square foot shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be shown on the shop (detail) drawings and the structure shall be strengthened as required. The Contractor is responsible for providing the truss manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds before design of the building commences.

#### 1.4.3 Roof Live Loads

##### 1.4.3.1 Uniform Loads

A uniform roof live load of 20 psf, including maintenance traffic and construction loads, shall be applied in accordance with ASCE 7.

##### 1.4.3.2 Concentrated Loads

In addition to roof live loads, a minimum design concentrated load of 300 pounds shall be used to simulate a construction load on roof panels.

#### 1.4.4 Roof Snow Loads

The design roof snow loads, including effects of drifting, shall be determined based on the ground snow load shown on the drawings.

#### 1.4.5 Wind Loads

Wind uplift pressures are shown on the drawings.

#### 1.4.6 Seismic Loads

Seismic loads shall be computed for seismic zone 1 in accordance with ASCE 7 using an importance factor of 1.

### 1.5 DESIGN ANALYSIS

The design analysis shall be the design of a licensed Professional Engineer experienced in design of this work and shall include complete calculations for the trusses and required anchorage. All vertical and lateral forces shall be calculated and summarized. Formulas and references shall be identified. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design.

### 1.6 WORKMANSHIP

Cold formed steel trusses shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed welds shall be ground smooth. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 1.7 ANCHORAGE

Anchorage shall be provided where necessary for fastening joists securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

### 1.8 DEFLECTIONS

Maximum deflections under applied load combinations (including live load, snow or wind loads) shall not exceed 1/180th of the span length. The calculated deflection from the concentrated load shall not exceed 1/180th of the span length.

## PART 2 PRODUCTS

### 2.1 COLD FORMED STEEL

Steel trusses, bridging, and all associated framing components shall be constructed from cold formed steel conforming to the minimum requirements of ASTM A 446, Grade D, possessing a minimum yield of 50,000 psi.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations.

### 3.2 CONNECTIONS

#### 3.2.1 Welds

Welds shall be of the type, size and location shown (in the contract documents or approved shop drawings).

Welded connections shall be performed in accordance with the American Welding Society (AWS) Specification for Welding Sheet Steel in Structures, D1.3.

Consult applicable AWS specifications for information regarding safe welding procedures.

Welds shall be cleaned and coated with rust inhibitive galvanizing paint.

#### 3.2.2 Screws

Screws shall be of the type, size, and location shown (in the contract documents or approved shop drawings);

Screw penetration through jointed materials shall not be less than three exposed screw threads.

### 3.3 INSTALLATION, GENERAL

Prefabricated trusses shall be square, with components attached in a manner to prevent racking during fabrication, transportation and lifting. Provisions to lift the panel shall be included in the frame's design and construction.

Field cutting of steel framing members shall be by saw or shear. Torch cutting will not be permitted except, by written approval of the Engineer or Record.

Temporary bracing shall be provided and remain in place until work is permanently stabilized.

Splicing of framing components is not permitted.

Provide web stiffeners at all end support locations.

Mechanical bridging shall be installed before loading.

End blocking shall be provided where truss ends are not restrained against rotation.

Provide additional framing around openings when the width of the opening exceeds the typical truss spacing.

-- End of Section --

## SECTION 06100

## ROUGH CARPENTRY

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111 (1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307 (1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus

ASTM C 591 (1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C 665 (1995) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C 1289 (1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM E 84 (1996a) Surface Burning Characteristics of Building Materials

ASTM E 96 (1995) Water Vapor Transmission of Materials

ASTM E 154 (1988; R 1993) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

ASTM F 547 (1977; R 1990) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2 (1995) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

AWPA C9 (1995) Plywood - Preservative Treatment by Pressure Processes

AWPA M4	(1995) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(1996) Standards for Waterborne Preservatives
APA - THE ENGINEERED WOOD ASSOCIATION (APA)	
APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
CALIFORNIA REDWOOD ASSOCIATION (CRA)	
CRA-01	(1997) Standard Specifications for Grades of California Redwood Lumber
FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)	
FM LPD 1-49	(1995) Loss Prevention Data Sheet - Perimeter Flashing
NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)	
NHLA-01	(1994) Rules for the Measurement & Inspection of Hardwood & Cypress
NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)	
NELMA-01	(1997) Standard Grading Rules for Northeastern Lumber
SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)	
SCMA-01	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress
SOUTHERN PINE INSPECTION BUREAU (SPIB)	
SPIB 1003	(1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber
WEST COAST LUMBER INSPECTION BUREAU (WCLIB)	
WCLIB Std 17	(1996; Supples VII(A-E), VIII(A-C)) Grading Rules for West Coast Lumber
WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)	
WWPA-01	(1995; Supple Nos. 1 thru 5) Western Lumber Grading Rules 95

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Grading and Marking; Pressure Preservative Treated Dimensional Lumber and Plywood.

Manufacturer's certificates (approved by an American Lumber Standards

approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

### 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

## PART 2 PRODUCTS

### 2.1 LUMBER AND SHEATHING

#### 2.1.1 Grading and Marking

##### 2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

##### 2.1.1.2 NOT USED

##### 2.1.1.3 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

##### 2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

##### 2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWP A M4. The following items shall be treated:

- a. Wood members in contact with or within 18 inches of soil.
- b. Wood members in contact with water.
- c. Wood members exposed to the weather including those used in roofing systems or as nailing strips or nailers.
- d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

##### 2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 4 inches or less, nominal thickness, 19 percent maximum. 5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.

b. Roof Planking: 15 percent maximum.

c. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 NOT USED

2.1.10 NOT USED

2.1.11 NOT USED

2.1.12 Miscellaneous Wood Members

2.1.12.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
_____	_____
Furring	1 x 3.
Nailing strips	2 inch stock.

2.1.12.2 Wood Bumpers

Bumpers shall be of the species and grade in accordance with TABLE II at the end of this section, size as shown.

### 2.1.12.3 Sill Plates

Sill plates shall be standard or number 2 grade.

### 2.1.12.4 Blocking

Blocking shall be standard or number 2 grade.

### 2.1.12.5 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

## 2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

### 2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

### 2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

### 2.2.3 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

### 2.2.4 Expansion Shields

Type and size best suited for intended use.

### 2.2.5 NOT USED

### 2.2.6 NOT USED

### 2.2.7 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T01. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

## 2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown.

R-values shall be determined at 75 degrees F in accordance with ASTM C 518.

Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher

recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

#### 2.3.1 Batt or Blanket

##### 2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation, Class A, having a UL rating of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84. Width and length shall suit construction conditions.

#### 2.3.2 NOT USED

#### 2.3.3 NOT USED

#### 2.3.4 Rigid Insulation

##### 2.3.4.1 NOT USED

##### 2.3.4.2 Polyurethane or Polyisocyanurate Board

Polyurethane or polyisocyanurate board shall have a minimum recovered material content of 9 percent by weight of core material in the polyurethane or polyisocyanurate portion. Unfaced preformed polyurethane shall conform to ASTM C 591. Faced polyisocyanurate shall conform to ASTM C 1289.

#### 2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 0.5 perms as determined in accordance with ASTM E 96, unless otherwise specified.

### PART 3 EXECUTION

#### 3.1 NOT USED

#### 3.2 NOT USED

#### 3.3 NOT USED

#### 3.4 NOT USED

#### 3.5 NOT USED

#### 3.6 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

##### 3.6.1 NOT USED

##### 3.6.2 NOT USED

##### 3.6.3 Blocking

Blocking shall be provided as necessary for application of wallboard, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 8 feet for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

##### 3.6.4 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

### 3.6.5 NOT USED

### 3.6.6 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 16 inches on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

### 3.6.7 Rough Bucks and Frames

Rough bucks shall be set straight, true, and plumb, and secured with anchors near top and bottom of each wood member and at intermediate intervals of not more than 3 feet. Anchors for concrete shall be expansion bolts, and anchors for masonry shall be 3/16 x 1-1/4 inch steel straps extending not less than 8 inches into the masonry and turned down 2 inches into the masonry.

### 3.6.8 Wood Bumpers

Wood bumpers shall be bored, countersunk and securely bolted in place.

### 3.6.9 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.

### 3.7 NOT USED

### 3.8 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

### 3.9 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied to provide a continuous barrier at window and door frames, and at all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations. Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

### 3.10 NOT USED

TABLE I. SPECIES AND GRADE

Subflooring, Roof Sheathing, Wall Sheathing, Furring

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA-01	Cypress			X	
NELMA-01	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock-Tamarack				X
CRA-01	Redwood		X		
SCMA-01	Cypress			X	
SPIB 1003	Southern Pine		X		
WCLIB Std 17	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA-01	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
NHLA-01	Red Oak	X	
NELMA-01	Northern Pine		X
	Eastern Hemlock-Tamarack		X
SPIB 1003	Southern Pine	X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
WCLIB Std 17	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA-01	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X

-- End of Section --

## SECTION 07110

## BITUMINOUS DAMPPROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4479	(1993) Asphalt Roof Coatings - Asbestos Free

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-13 Certificates

Materials; Asphaltic Primer Fibrated, Solvent-Based Asphalt Dampproofing; Certificates attesting that the materials meet the requirements specified.

## 1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous dampproofing work specified to meet the requirements of the contract.

## 1.4 DELIVERY, STORAGE AND HANDLING

Dampproofing materials shall be delivered to the project site in the original sealed containers bearing the name of manufacturer, contents and brand name, and stored in a weathertight enclosure to prevent moisture damage and absorption. Dampproofing materials shall be protected from freezing. Asphalt shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup; and therefore, shall not be used to cover dampproofing materials. Care shall be taken during storage to avoid separation or settlement of the emulsion components. Damaged or deteriorated materials shall be removed from the project site.

## PART 2 PRODUCTS

## 2.1 NOT USED

## 2.2 SOLVENT-BASED ASPHALT DAMPPROOFING

## 2.2.1 Asphaltic Primer

Primer for cold-applied solvent-based asphalt dampproofing shall conform to

ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

### 2.2.2 Fibrated Asphalt

Fibrated solvent-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 4479 Type I, asbestos-free, manufactured with selected asphalts, stabilizers, mineral spirits and fibrated with mineral fibers. Solvent-based asphalt shall contain 72 percent solids by weight, 65 percent solids by volume.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous dampproofing shall be prepared in accordance with dampproofing manufacturer's recommendations. Surface preparation shall be approved prior to dampproofing application.

#### 3.1.1 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

#### 3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

#### 3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage the dampproofing materials and impair performance shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar.

#### 3.1.4 Metal Surfaces

Metal surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

### 3.2 APPLICATION OF BITUMINOUS DAMPPROOFING

#### 3.2.1 NOT USED

#### 3.2.2 Solvent-Based Asphalt

Solvent-based asphalt dampproofing work shall not be performed in temperatures below 40 degrees F. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film not less than 12 mils thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

- a. Primer: 1/2 gallon per 200 square feet, cold-applied.
- b. Dampproofing Coat: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

### 3.3 CLEAN-UP

Surfaces of other work which are stained with dampproofing materials shall be cleaned with a cleaner recommended by dampproofing manufacturer.

3.4 PROTECTION

The completed dampproofing work shall be protected from damage during and after construction.

-- End of Section --

## SECTION 07111

## ELASTOMERIC MEMBRANE WATERPROOFING

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	(1981) Rubber Products
ASTM D 412	(1987) Rubber Properties in Tension
ASTM D 471	(1979) Rubber Property - Effect of Liquids
ASTM D 624	(1986) Rubber Property - Tear Resistance
ASTM D 1004	(1966, R 1988) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 4637	(1987) Vulcanized Rubber Sheet Used in Single-Ply Roof Membrane
ASTM E 96	(1990) Water Vapor Transmission of Materials
ASTM E 154	(1988) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM G 21	(1970, R 1985) Determining Resistance of Synthetic Polymeric Materials to Fungi

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## SD-04 Drawings

Waterproofing System; GA.

Detail drawings showing size of sheets, position of sheets and splices, flashing and termination details, and expansion joint details.

## SD-06 Instructions

Installation; GA.

Manufacturer's instructions for installation of the elastomeric membrane, including procedures for preparing the membrane for use, flashing, and splicing. Instructions shall include recommended or required protective

covering and procedures for safe handling and use of cleaners, adhesives, and sealants.

SD-13 Certificates

Materials; GA.

Certificates of compliance attesting that the materials meet specification requirements. Certificates may show qualification of the identical compound in the specified test.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered to the job site in unopened containers bearing the manufacturer's name, brand name, and description of contents. Membrane, flashing, and adhesives shall be stored in clean, dry areas. Storage temperature for adhesives shall be between 60 and 80 degrees F. Protection board shall be stored flat and off the ground.

PART 2 PRODUCTS

2.1 MATERIALS

All adhesives, mastics, cements, tapes, and primers shall be as recommended by the membrane manufacturer and shall be compatible with the materials to which they are to be bonded.

2.1.1 Performance Requirements

All membranes shall meet the following requirements when tested by the referenced ASTM standards:

Puncture Resistance (ASTM E 154)	40 pounds, minimum
Water Vapor Transmission at 80 degrees F Permeance (ASTM E 96, Procedure B)	0.25 perms (max.)
Resistance to Soil Bacteria or Fungi (ASTM G 21 or ASTM E 154)	No sustained growth or discoloration after 21 days

2.1.1.1 Butyl Rubber

Thickness, plus or minus 10 percent	60 mils
Specific Gravity (ASTM D 297)	1.2 plus or minus 0.05
Tensile Strength (ASTM D 412)	1200 psi (min.)
Elongation (ASTM D 624)	300 percent (min.)
Tear Resistance (ASTM D 624)	125 lb./inch (min.)
Water Absorption (ASTM D 471) 158 degrees F, 168 hours	plus 2 percent (max.)

2.1.1.2 Plastic Elastomeric Sheeting

Membrane shall be a minimum of 56 mils thick and shall meet the following requirements:

Tensile Strength (ASTM D 412, Die C)	220 psi (min)
Elongation (ASTM D 412, Die C)	250 percent (min.)
Tear Resistance (ASTM D 1004)	350 lb./inch (min.)

#### 2.1.1.3 Composite Self-Adhering Membrane

Membrane shall be a polymeric sheeting integrally bonded to rubberized asphalt with a minimum thickness of 60 mils.

#### 2.1.1.4 Chlorinated Polyethylene (CPE) Sheeting

Membrane shall be uncured chlorinated polyethylene, synthetic elastomeric sheeting of 40 mils nominal thickness.

#### 2.1.1.5 Chloroprene

Chloroprene membrane shall conform to ASTM D 4637, Type II, Grade 1, Class U, 60 mils minimum thickness.

#### 2.1.1.6 Ethylene Propylene Diene Monomer (EPDM) Membrane

EPDM membrane shall conform to ASTM D 4637, Type I, Grade I, Class U, 60 mils minimum thickness.

#### 2.1.2 Protection Board

Protection board for waterproofing membrane shall be 1/2-inch minimum asphalt plank, 1/2-inch fiberboard or premolded bituminous protection board; 1/8-inch thick for vertical surfaces, and 1/4-inch thick for horizontal surfaces. The membrane and protection board must be compatible.

#### 2.2 ACCESSORIES

Flashing, counterflashing, expansion joint covers and corner fillets shall be as recommended by the membrane manufacturer.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Surfaces to which waterproofing is to be applied shall be clean, smooth, and free from deleterious materials and projections. Holes, honeycomb, cracks, or cavities shall be pointed or filled and finished flush with portland cement mortar. Top surfaces of projecting metal or concrete ledges below grade, except footings, shall be beveled. Before waterproofing is applied, the surfaces to be covered shall be swept or brushed carefully to remove all dust and foreign matter. Concrete surfaces to receive elastomeric waterproofing will not be cured with compounds containing wax or oil.

#### 3.2 APPLICATION

Waterproofing shall not be applied to wet surfaces. The ambient and surface temperatures shall be above 40 degrees F during application. Membrane under slabs shall be carried up abutting vertical surfaces to the level of finish of floor or to within 1/2 inch of the top edge of base where base is shown and cemented solid to the substrate. Membrane shall not be continuous through walls, floors, piers, and columns unless otherwise shown. Concrete surfaces shall be primed to receive the membrane. Membranes shall be handled and installed in accordance with the approved installation

instructions. All primers, adhesives, and mastics shall be applied in accordance with the membrane manufacturer's printed instructions. Laps shall be oriented so that water will flow over the lap, and not into them. As soon as the mastic is fully set and dry, joints shall be checked. Where any openings or fishmouths appear, joints shall be resealed and rerolled. Wrinkles and buckles shall be avoided in applying membrane and joint reinforcement. Nonadhering membranes shall be unrolled and allowed to remain flat for at least 2 hours before application. Membranes shall be drawn tight during installation without stretching. Self-adhering membrane shall be installed by removing the release sheets on the back of the membrane and applying the tacky surface onto the primed surface. Laps and splices shall be sealed prior to completion of a day's work.

### 3.2.1 Butyl Rubber

Each sheet shall be lapped at sides and ends a minimum of 6 inches over the preceding sheet. Lap and splice areas of membrane shall be cleaned with heptane, hexane, or white gasoline. Six-inch-wide unvulcanized compounded butyl tape shall be applied between lapped splices so that the tape extends approximately 1/4 inch beyond the exposed sheeting edge. The tape shall be rolled firmly into place as it is applied. Tape backing shall be removed and the lapped sheeting rolled or pressed into place. Splicing adhesive shall be applied to the lapped area 3-1/2 inches on either side of the lapped edge. The splice adhesive shall be allowed to dry thoroughly and the lap reinforced with 6-inch-wide unvulcanized compounded butyl tape. Full contact shall be made for all lap areas. Corner splices and flashing overlaps shall be reinforced with a 12-inch-wide strip of membrane over one layer of butyl tape or with a prefabricated corner of butyl rubber.

### 3.2.2 Plastic Elastomeric Sheeting

Sheeting shall be applied in sections no longer than 18 feet. Each sheeting shall be lapped at sides and ends a minimum of 6 inches over the preceding sheet. Lap splices shall be reinforced with 12-inch-wide strips of plastic sheeting or as recommended in the approved installation instructions. Lap and splices shall be sealed in a full bed of adhesive at the rate recommended by the manufacturer of the material. Sheeting and joint strips shall be rolled with a 50 to 100 pound roller on horizontal surfaces, and a 6-inch rubber hand roller on vertical surfaces.

### 3.2.3 Composite Self-Adhering Membrane

On vertical surfaces, membrane shall be applied in lengths up to 8 feet starting at the bottom. Each sheet shall be lapped at edges and ends a minimum of 2-1/2 inches over the preceding sheets. The membrane shall be rolled to adhere with the substrate. Corners and joints shall be double-covered by first applying a 12-inch width of membrane centered along the corner joint. Inside and outside corners shall then be covered with membrane. Exposed termination edges of membrane on horizontal or vertical surfaces shall be finished with a troweled bead of mastic. Mastic shall be applied around termination edges of membrane and around drains and projections. Mastic shall be applied at the termination of each day's work.

### 3.2.4 Chlorinated Polyethylene (CPE) Sheeting

Sheets shall be lapped at edges and ends a minimum of 2-1/2 inches over the preceding sheet. All horizontal membranes shall overlap vertical surfaces by at least 3 inches.

### 3.2.5 Chloroprene Rubber Sheeting

Each sheet shall overlap the previously installed sheet by a minimum of 3 inches. Sheet shall be folded lengthwise to expose one half of the underside of the sheet for cleaning the sheet with cleaner recommended by the manufacturer. Adhesive shall be applied to sheet and substrate. Two coats of adhesive are required on the substrate with 1/2-hour between coats. Sheet shall not be bonded to substrate until adhesive does not come off at a dry finger touch. Chalk lines or masking tape shall be used as guides for adhesive application and positioning sheets. After adhesive has dried, sheet shall be folded back onto the substrate or previously applied sheet membrane. Membrane shall be rolled to obtain complete adhesion. The exposed edge of each sheet shall be further sealed with a fillet-shaped bead of adhesive, tooled to obtain positive contact with the surface of both sheets.

### 3.3 TESTS

When required, and after the system is cured, the membranes on horizontal surfaces shall be tested by flooding the entire waterproofed area with a minimum of 2 inches head of water for a period of 24 hours. There shall be no water added after the start of the period. Measure water level at the beginning and at the end of the 24-hour period. If the water level falls, remove the water and inspect the waterproofing membrane. Leak sites shall be marked, dried and repaired, and the test shall be repeated.

### 3.4 PROTECTION

Horizontal applications of membrane shall be protected from traffic during installation. No equipment shall be allowed directly on the membrane. Plywood, or similar material, overlayment shall be provided for wheel-ways. Walkways shall be provided where heavy traffic from other trades is expected. Materials shall not be stored on the membrane. A protective covering shall be installed over the membrane immediately after installation or testing. If membrane is to be exposed, a temporary covering shall be applied to protect the membrane until the protection board is installed.

#### 3.4.1 Projections

Projections passing through membrane shall be flashed as recommended by the manufacturer of the waterproofing membrane.

#### 3.4.2 Counterflashing

Waterproofing connecting with work exposed to the weather shall be counterflashed to form a water-tight connection. Upper edge of membrane waterproofing and protective covering shall be counterflashed.

#### 3.4.3 Expansion Joints and Fillets

Expansion joints and corner fillets shall be installed as recommended by the manufacturer of the waterproofing membrane.

#### 3.4.4 Vertical Membrane Waterproofing

Waterproofing shall be protected with a 1/2-inch minimum fiberboard, 1/2-inch asphalt-impregnated fiberboard or 1/8-inch compatible water-resistant (bitumen type) protection board. Edges of protection shall be butted, and exposed surfaces shall be covered by a coating of bitumen.

3.4.5 Horizontal Membrane Waterproofing

Waterproofing shall be covered with portland cement mortar not less than 3/4 inch thick, uniformly placed and allowed to set before subsequent construction is installed.

-- End of Section --

## SECTION 07412

## NON-STRUCTURAL METAL ROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1996a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1997) Steel Sheet, 5% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 1289	(1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1994) Specular Gloss
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995a) Measuring Adhesion by Tape Test
ASTM D 4214	(1997) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies
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## 1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies the specified design and additional requirements contained herein. The roofing system shall be provided by the Contractor as a complete system, as tested and approved in accordance with UL 580. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

### 1.2.1 Non-Structural Metal Roof System

This section applies to the roof for the Operations Building and the Pumphouse only. The Non-Structural Metal Roof System covered under this specification shall include the entire roofing system; the metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts, eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the system.

### 1.2.2 Manufacturer

The non-structural metal roofing system shall be the product of a manufacturer who has been in the practice of manufacturing metal roofs for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

### 1.2.3 Installer

The installer shall be certified by the metal roof manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

## 1.3 DESIGN LOADS

Wind uplift pressures are shown on the contract drawings. Non-structural

Metal Roof System assemblies shall be approved to resist wind uplift pressures of Class 90 as defined in UL 580.

#### 1.4 PERFORMANCE REQUIREMENTS

The metal roofing system supplied shall conform to the roof slope, the underlayment, and uplift pressures shown on the contract drawings. The Contractor shall furnish a commercially available roofing system which satisfies all the specified requirements.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Metal Roofing; GA.

a. Drawings consisting of catalog cuts, flashing details, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be provided by the metal roofing manufacturer.

b. Drawings showing the UL 580, Class 90 tested roof system assembly.

##### SD-13 Certificates

Roof Panels; GA. Installation; GA. Accessories; GA.

Certificates attesting that the panels and accessories conform to the specified requirements. Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least 3 representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.

Insulation; GA.

Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Installer; GA.

Certification of installer.

Warranties; GA.

At the completion of the project, signed copies of the 5-year Warranty for Non-Structural Metal Roofing System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material and Weathertightness Warranties.

##### SD-14 Samples

Accessories; FIO.

One sample of each type of flashing, trim, fascia, closure, cap and similar

items. Size shall be sufficient to show construction and configuration.

Roof Panels; FIO.

One piece of each type and finish to be used, 9 inches long, full width.

Fasteners; FIO.

Two samples of each type to be used with statement regarding intended use. If so requested, random samples of screws, bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample, approximately 1 pound, and descriptive data.

#### 1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weather tight coverings and kept dry. Material shall not be covered with plastic where such covering will allow sweating and condensation. Plastic may be used as tenting with air circulation allowed. Storage conditions shall provide good air circulation and protection from surface staining.

#### 1.7 WARRANTIES

The Non-Structural Metal Roofing System shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

##### 1.7.1 Contractor's Weathertightness Warranty

The Non-Structural Metal Roofing System shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The roofing covered under this warranty shall include the entire roofing system, including but not limited to, the roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the roof system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written

warranty shall be as outlined in attached WARRANTY FOR NON-STRUCTURAL METAL ROOF SYSTEM, and shall start upon final acceptance of the facility. It is required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the 5 year Contractor's warranty period for the entire roofing system as outlined above.

#### 1.7.2 Manufacturer's Material Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all Non-Structural Metal Roofing System components such as roof panels, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, fail structurally, or perforate under normal atmospheric conditions at the site. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing or replacing the defective coated coil material.

c. A roofing system manufacturer's 20 year system weathertightness warranty.

#### 1.8 COORDINATION MEETING

A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal roofing system contract requirements.

This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing system manufacturer, the roofing supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

### PART 2 PRODUCTS

#### 2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide nominal 16 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut. The ridge cap shall be installed as recommended by the metal roofing manufacturer. Height of corrugations, ribs, or seams, at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

##### 2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or

aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated roof panels shall be 0.024 inch thick minimum. Panels shall be within 95 percent of the nominal thickness.

## 2.2 ACCESSORIES

Accessories shall be compatible with the roofing furnished. Flashing, fascia panels, trim, metal closure strips, caps, snow guards, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.

### 2.2.1 Snow Guards

Snow guards to be a low profile, traditional style and engineered for permanent installation by means of soldering or adhesive sealant to metal roof surface. Color to match roof. Refer to plans for location.

## 2.3 FASTENERS

Fasteners for roof panels shall be zinc-coated steel, aluminum, or nylon capped steel, type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the roofing to waterproof the fastener penetration. Washer material shall be compatible with the panels; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

## 2.4 FACTORY COLOR FINISH

Panels shall have a factory applied silicone-modified polyester coating system on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 2 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 1.0 mil thickness. The exterior color finish shall meet the test requirements specified below.

### 2.4.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blistering, as determined by ASTM D 714; and a rating of 8, 1/32 inch failure at scribe, as determined by ASTM D 1654.

### 2.4.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

### 2.4.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be

considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244.

#### 2.4.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.4.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

#### 2.4.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on the steel base metal.

#### 2.4.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 30 at 60 degrees when measured in accordance with ASTM D 523.

#### 2.4.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

### 2.5 UNDERLAYMENTS

#### 2.5.1 Felt Underlayment

Felt underlayment shall be No. 30 felt in accordance with ASTM D 226, Type II.

### 2.6 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

#### 2.6.1 Rigid Board Insulation for Use Above a Roof Deck

##### 2.6.1.1 Polyisocyanurate

Polyisocyanurate insulation shall conform to ASTM C 1289, Type I, Class 2 (having a minimum recovered material content of 9 percent by weight of core

material in the polyisocyanurate portion). For impermeable faced polyisocyanurate (Ex: aluminum foil) the maximum design R-value per 1 inch of insulation used shall be 7.2.

## 2.7 INSULATION RETAINERS

Insulation retainers shall be type, size, and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

## 2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

## 2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Roof panel attachment clips shall be secured to the metal deck as a minimum, or by means recommended by the roof manufacturer. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

### 3.1.1 Roofing

Side laps shall be laid away from the prevailing winds. Side and end lap distances, joint sealing, and fastening and spacing of fasteners shall be in accordance with manufacturer's standard practice. Spacing of exposed fasteners shall present an orderly appearance. Side laps and end laps of roof panels and joints at accessories shall be sealed. Fasteners shall be driven normal to the surface. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weathertight installation. Accessories shall be fastened into substrate, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

### 3.1.2 NOT USED

### 3.1.3 Underlayment

Underlayment types shall be installed where shown on the drawings; they shall be installed directly over the substrate. If a roof panel rests directly on the underlayments, a slip sheet shall be installed as a top layer, beneath the metal roofing panels, to prevent adhesion. All underlayments shall be installed so that successive strips overlap the next

lower strip in shingle fashion. Underlayments shall be installed in accordance with the manufacturer's written instructions. The underlayments shall ensure that any water that penetrates below the metal roofing panels will drain outside of the building envelope.

### 3.2 INSULATION INSTALLATION

Insulation shall be installed as indicated and in accordance with manufacturer's instructions. Insulation shall be continuous over entire roof surface and fastened directly to the substrate with mechanical fasteners. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation and vapor retarder providing equivalent R-Value and perm rating as remaining insulation.

### 3.3 NOT USED

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION \_\_\_\_\_

BUILDING NUMBER: \_\_\_\_\_

CORPS OF ENGINEERS CONTRACT NUMBER: \_\_\_\_\_

CONTRACTOR

CONTRACTOR: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

POINT OF CONTACT: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

OWNER

OWNER: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

POINT OF CONTACT: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

CONSTRUCTION AGENT

CONSTRUCTION AGENT: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

POINT OF CONTACT: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM  
(continued)

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY \_\_\_\_\_ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON \_\_\_\_\_ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

\_\_\_\_\_  
(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOFING SYSTEM  
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOF DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

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CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM  
(continued)

\*\*REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

## SECTION 07600

## SHEET METALWORK, GENERAL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free

## INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089	(1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)
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## SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993; Errata) Architectural Sheet Metal Manual
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## 1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction.

## 1.2.1 Coordination

Cutting, fitting, drilling, and other operations in connection with sheet

metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Materials; GA.

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA-02 for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA-02. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

#### 2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

#### 2.1.2 Aluminum Extrusions

ASTM B 221, Alloy 6063, Temper T5.

#### 2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586.

#### 2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

#### 2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

#### 2.1.6 Felt

ASTM D 226, Type I.

#### 2.1.7 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 0.075 inch minimum thickness.

#### 2.1.8 Aluminum Alloy Sheet and Plate

ASTM B 209, form, alloy, and temper appropriate for use.

#### 2.1.9 Copper

ASTM B 370, Temper H 00.

#### 2.1.10 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

#### 2.1.11 Solder

ASTM B 32, 95-5 tin-antimony.

#### 2.1.12 Through-Wall Flashing

- a. Electro-sheet copper not less than 5 ounces, factory coated both sides with acid- and alkali-resistant bituminous compound not less than 6 ounces per square foot or factory covered both sides with asphalt-saturated cotton fabric, asphalt saturated glass-fiber fabric, or with 40 pound reinforced kraft paper bonded with asphalt.

#### 2.1.13 Louver Screen

Type I commercial bronze, Type II carbon steel, Type III aluminum alloy insect screening conforming to ISWA IWS 089.

### PART 3 EXECUTION

#### 3.1 GENERAL

Items such as gutters, downspouts and louvers shall be fabricated in conformance with SMACNA-02 and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

#### 3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA-02. Expansion joints in continuous sheet metal shall be provided at 40 foot intervals for copper and stainless steel and at 32 foot intervals for aluminum, except extruded aluminum fasciae which shall have expansion joints at not more than 12 foot spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

#### 3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action

by one of the following methods:

### 3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL.

### 3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

## 3.4 CONNECTIONS AND JOINTING

### 3.4.1 Soldering

Soldering shall apply to copper, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

### 3.4.2 Riveting

Joints in aluminum sheets 0.040 inch or less in thickness shall be mechanically made.

### 3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 1 inch wide. Unsoldered plain-lap seams shall lap not less than 3 inches unless otherwise specified. Flat seams shall be made in the direction of the flow.

## 3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 1/8 inch apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

## 3.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be installed as indicated. Gutters shall be supported by continuous cleats. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations.

## 3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be

covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

### 3.7.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 3 inches on centers.

### 3.7.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown in SMACNA-02. Counter flashing shall be factory formed to provide spring action against the base flashing.

### 3.7.3 NOT USED

### 3.7.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

#### 3.7.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 2 inches, or shall be applied over top of masonry and precast concrete lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

#### 3.7.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 4 inches beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill.

### 3.7.5 Valley Flashing

Valley flashing shall be installed as specified in SMACNA-02 and as indicated.

### 3.8 FASCIA

Fascia shall be fabricated and installed as indicated and in accordance with SMACNA-02.

### 3.9 INSTALLATION OF LOUVERS

Louvers shall be rigidly attached to the supporting construction. The installation shall be rain-tight. Louver screen shall be installed as indicated.

### 3.10 REGLETS

Reglets shall be a factory fabricated product of proven design, complete with fittings and special shapes as required. Open-type reglets shall be

filled with fiberboard or other suitable separator to prevent crushing of the slot during installation. Reglet plugs shall be spaced not over 12 inches on centers and reglet grooves shall be filled with sealant. Friction or slot-type reglets shall have metal flashings inserted the full depth of slot and shall be lightly punched every 12 inches to crimp the reglet and counter flashing together. Polyvinyl chloride reglets shall be sealed with the manufacturer's recommended sealant.

### 3.11 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

-- End of Section --

## SECTION 07810

## SPRAY-APPLIED FIREPROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 605	(1993; R 1996) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 759	(1992; R 1996) Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 760	(1992; R 1996) Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 761	(1992) Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 937	(1993) Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 1042	(1992) Acoustically Absorptive Materials Applied by Trowel or Spray
ASTM G 21	(1990) Determining Resistance of Synthetic Polymeric Materials to Fungi

## UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1998) Fire Resistance Directory (2 Vol.)
UL 263	(1997) Fire Tests of Building Construction and Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Fireproofing Material; GA.

Data identifying performance characteristics of fireproofing material. Data shall include recommended application requirements and indicate thickness of fireproofing that must be applied to achieve each required fire rating.

## SD-09 Reports

UL Test Assembly; GA.

Reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method.

Field Tests; FIO.

Test reports documenting results of tests on the applied material in the project. Report shall include defects identified, repair procedures, and results of the retests when required.

## SD-13 Certificates

Installer Qualifications; GA.

Manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Evidence that each fireproofing installer has had a minimum of 3 years experience in installing the specified type of fireproofing.

Surface Acceptability; FIO.

Manufacturer's certification that surfaces to be protected have been inspected and are acceptable to receive spray-applied fireproofing. The statement shall list the structural members and the areas that have been inspected and certified.

Manufacturer's Inspection; GA.

Manufacturer's certification that the spray-applied fireproofing in the entire project complies with the manufacturer's criteria and recommendations.

## SD-14 Samples

Spray-Applied Fireproofing; FIO.

One sample panel, 18 inches square, for each specified type of fireproofing. Also, a designated sample area of not less than 100 square feet shall be prepared. Sample area shall be representative of typical installation of fireproofing including metal decks, beams, columns and attachments. Equipment, materials and procedures used in the sample area shall be the same as, or representative of, that to be used in the work. The sample area shall be approved prior to proceeding with fireproofing work in any other area. The approved sample area shall be used as a reference standard for applied fireproofing material. Sample area shall remain in place and open to observation until all spray-applied fireproofing is completed and accepted, at which time it may become part of the work.

## 1.3 DELIVERY AND STORAGE

Packaged material shall be delivered in the original unopened containers, marked to show the names of the brand and the manufacturer. Fireproofing material shall be kept dry until ready to be used, and shall be stored off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Material with shelf-life shall be applied prior to expiration of the shelf-life.

#### 1.4 ENVIRONMENTAL CONDITIONS

##### 1.4.1 Temperature

Substrate and ambient air temperatures shall be maintained above 40 degrees F during application and for 24 hours before and after application. Relative humidity shall be maintained within the limits recommended by the fireproofing manufacturer.

##### 1.4.2 Ventilation

Adequate ventilation shall be provided to properly dry the fireproofing after application. In enclosed areas, a minimum of 4 air exchanges per hour shall be provided by forced air circulation.

#### 1.5 INSTALLER QUALIFICATIONS

Each installer of fireproofing material shall be trained and have a minimum of 3 years experience in the installation of fireproofing of the type specified.

#### 1.6 NOT USED

#### 1.7 FIRE RESISTANCE RATING

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resist Dir. Proposed materials not listed in UL Fire Resist Dir shall have fire resistance ratings at least equal to the UL Fire Resist Dir ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E 119.

#### 1.8 EXTENT OF FIREPROOFING

Structural steel, roof purlins, wall girts, and the underside of steel floor and steel roof decks shall be protected with spray-applied fireproofing to a fire resistance hour-rating of 1 hour unless otherwise indicated.

### PART 2 PRODUCTS

#### 2.1 SPRAY-APPLIED FIREPROOFING

Spray-applied fireproofing material, including sealer, shall conform to ASTM E 1042, Class (a), Category A, either Type I or Type II, except that the dust removed shall not exceed 0.0025 gram per square foot of fireproofing material applied as specified in the project. Material shall be asbestos free, and shall resist fungus for a period of 28 days when tested in accordance with ASTM G 21.

##### 2.1.1 Dry Density and Cohesion/Adhesion

Fireproofing shall have a minimum ASTM E 605 dry density and ASTM E 736 cohesion/adhesion properties as follows:

##### 2.1.1.1 Concealed Structural Components

Fireproofing for structural components concealed above the ceiling, or within a wall, chase, or furred space, shall have a minimum average applied

dry density of 15 pounds per cubic foot and a cohesion/adhesion strength of 200 pounds per square foot.

#### 2.1.1.2 Exposed Structural Components

Fireproofing for exposed structural components, except where otherwise specified or indicated, shall have a minimum applied dry density of 22 pounds per cubic foot and a cohesion/adhesion strength of 300 pounds per square foot.

#### 2.1.1.3 Mechanical Rooms and Storage Areas

Fireproofing for structural components located in mechanical rooms and storage areas shall have a minimum applied dry density of 40 pounds per cubic foot and a cohesion/adhesion strength of 400 pounds per square foot.

#### 2.1.2 Deflection

Spray-applied fireproofing shall not crack, spall, or delaminate when tested in accordance with ASTM E 759.

#### 2.1.3 Bond-Impact

Spray-applied fireproofing material shall not crack, spall or delaminate when tested in accordance with ASTM E 760.

#### 2.1.4 Compressive Strength

The minimum compressive strength shall be 1000 psf when tested in accordance with ASTM E 761.

#### 2.1.5 Corrosion

Spray-applied fireproofing material shall not contribute to corrosion of test panels when tested as specified in ASTM E 937.

#### 2.2 SEALER

Sealer shall be the type approved by the manufacturer of the fireproofing material and shall be white color.

#### 2.3 WATER

Water used for material mixing and surface preparation shall be potable.

### PART 3 EXECUTION

#### 3.1 SURFACE PREPARATION

Surfaces to be fireproofed shall be thoroughly cleaned of dirt, grease, oil, paint, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be coordinated with the manufacturer and detailed in submittal item SD-01 Data.

#### 3.2 PROTECTION

Surfaces not to receive spray-applied fireproofing shall be covered to prevent contamination by splatter, rebound and overspray. Exterior

openings in areas to receive spray-applied fireproofing shall be covered prior to and during application of fireproofing with tarpaulins or other approved material. Surfaces not to receive fireproofing shall be cleaned of fireproofing and sealer.

### 3.3 MIXING

Fireproofing material shall be mixed in accordance with the manufacturer's recommendations.

### 3.4 APPLICATION

#### 3.4.1 Sequence

Prior to application of fireproofing on each floor, the manufacturer shall inspect and approve application equipment, water supply and pressure, and the application procedures. Fireproofing shall be applied to underside of steel roof deck or steel floor assemblies only after respective roof or floor construction is complete. Fireproofing material shall be applied prior to the installation of ductwork, piping and conduits which would interfere with uniform application of the fireproofing. The Contractor shall not allow roof traffic during application and curing period.

#### 3.4.2 Application Technique

Water pressure and volume shall be maintained to manufacturer's recommendations throughout the fireproofing application. Fireproofing material shall be applied to the thickness established for the specified fire resistance rating, in accordance with the procedure recommended by the manufacturer, and to a uniform density and texture. Fireproofing material shall not be tamped to achieve the desired density. Sealer shall be applied to all fireproofing.

### 3.5 FIELD TESTS

The applied fireproofing shall be tested by an approved independent testing laboratory, in approved locations, for density, cohesion/adhesion force as specified, and for thickness in accordance with ASTM E 605. Two sets of tests shall be conducted on each floor or 10,000-square-foot area, whichever is less, at the approved locations. Any area showing less than minimum requirements shall be corrected. Proposed corrective measures, in writing, shall be approved before starting the corrective action. Corrected work shall be retested.

#### 3.5.1 Thickness, Density, Cohesion/Adhesion

Each structural component type shall be tested at floor and roof decks, beams, columns, joists, and trusses. Minimum average thickness shall be as indicated. Density and cohesion/adhesion shall be as specified.

#### 3.5.2 Repair

Additional fireproofing material may be added to provide proper thickness. Rejected areas of fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied. Repaired areas shall be retested and reinspected. Fireproofing material shall be applied to voids or damaged areas by hand-trowel, or by respraying.

-- End of Section --

## SECTION 07900

## JOINT SEALING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1981; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Backing; GA. Bond-Breaker; GA.

Sealant; GA.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

## SD-13 Certificates

Sealant; GA.

Certificates of compliance stating that the materials conform to the specified requirements.

## 1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

## 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

## PART 2 PRODUCTS

### 2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

#### 2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 1, open cell, or Type 2, closed cell, Class A, round cross section.

#### 2.1.2 PVC

Polyvinyl chloride (PVC) backing shall be ASTM D 1565, Grade VO 12, open-cell foam, round cross section.

#### 2.1.3 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods or tubes.

#### 2.1.4 Neoprene

Neoprene backing shall be ASTM D 1056, open cell neoprene sponge Type 1, Class C, Grade 1C3.

### 2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

### 2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

### 2.4 NOT USED

### 2.5 SEALANT

#### 2.5.1 LATEX

Latex Sealant shall be ASTM C 834.

#### 2.5.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. Polysulfide Sealant: Type S, Grade NS, Class 25, Use NT, M, G, A, O.
- b. Polyurethane sealant: Grade NS, Class 25, Use T, NT, M, G, A, O.

c. Silicone sealant: Type S, Grade NS, Class 25, Use NT, M, G, A, O.

2.5.3 NOT USED

2.5.4 BUTYL

Butyl sealant shall be ASTM C 1085.

2.5.5 NOT USED

2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has

been filled and tooled.

### 3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

### 3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

### 3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

### 3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

## 3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

-- End of Section --

## SECTION 08110

## STEEL DOORS AND FRAMES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 976	(1990) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box
ASTM D 2863	(1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

## DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115.1G	(1994) Installation Guide for Doors and Hardware
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## STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames
SDOI SDI-106	(1996) Standard Door Type Nomenclature
SDOI SDI-107	(1984) Hardware on Steel Doors (Reinforcement - Application)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Steel Doors and Frames; GA.

Drawings using standard door type nomenclature in accordance with SDOI SDI-106 indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of

metal. Drawings shall include catalog cuts or descriptive data for the doors, frames, and weatherstripping including air infiltration data and manufacturers printed instructions.

#### SD-13 Certificates

Thermal Insulated Doors; GA.

- a. Certification of Thermal Insulating Rating: Certification or test report for thermal insulated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

### 1.3 DELIVERY AND STORAGE

During shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or shall be provided with temporary steel spreaders at the bottom of each frame; and knockdown type frames shall be securely strapped in bundles. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting air circulation. Doors and assembled frames shall be stored in an upright position in accordance with DHI A115.1G.

Abraded, scarred, or rusty areas shall be cleaned and touched up with matching finishes.

### 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with SDOI SDI-100 and the additional requirements specified herein. Door grade shall be extra heavy duty (Grade III) unless otherwise indicated on the door and door frame schedules. Exterior doors and frames shall be designation G60 galvanized. Indicated interior doors and frames shall be designation A40 galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section 08700 BUILDERS' HARDWARE. Doors and frames shall be reinforced, drilled, and tapped to receive mortised hinges, locks, latches, and flush bolts as required. Doors and frames shall be reinforced for surface applied hardware. Frames shall be welded type located as shown. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 18 gauge steel or 7 gauge diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall be furnished for installation into factory predrilled holes in door frames; adhesively applied silencers are not acceptable. Where frames are installed in plaster or masonry walls, plaster guards shall be provided on door frames at hinges and strikes. Full glass doors shall conform to SDOI SDI-100, Model 3, and shall include provisions for glazing. Reinforcing of door assemblies for closers and other required hardware shall be in accordance with SDOI SDI-100 and the conditions of the fire door assembly listing when applicable. Exterior doors shall have top edges closed flush and sealed against water penetration.

### 2.2 NOT USED

### 2.3 THERMAL INSULATED DOORS

The interior of thermal insulated doors shall be completely filled with

rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 0.41 btu/hr times sq f times f when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

2.4 NOT USED

2.5 NOT USED

2.6 WEATHERSTRIPPING

Unless otherwise specified in Section 08700 BUILDERS' HARDWARE, weatherstripping shall be as follows: Weatherstripping for head and jamb shall be manufacturer's standard elastomeric type of synthetic rubber, vinyl, or neoprene and shall be installed at the factory or on the jobsite in accordance with the door frame manufacturer's recommendations. Weatherstripping for bottom of doors shall be as shown. Air leakage rate of weatherstripping shall not exceed 0.20 cfm per linear foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 FACTORY FINISH

Doors and frames shall be phosphatized and primed with standard factory primer system.

### PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with DHI A115.1G. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Weatherstripping shall be installed at exterior door openings to provide a weathertight installation. Hollow metal door frames shall be solid grouted in masonry walls as shown.

3.1.1 Thermal Insulated Doors

Hardware and perimeter seals shall be adjusted for proper operation. Doors shall be sealed weathertight after installation of hardware and shall be in accordance with Section 07900 JOINT SEALING.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be as indicated in the Exterior Finish Key.

-- End of Section --

## SECTION 08120

## ALUMINUM DOORS AND FRAMES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## 1.2 SYSTEM DESCRIPTION

Frames and swing-type aluminum doors, of size and design shown on the drawings, shall be provided at the locations indicated. Frames shall be furnished complete with doors, subframes, trim, and other accessories indicated and specified.

## 1.3 PERFORMANCE REQUIREMENTS

## 1.3.1 Wind Load Performance

Doors and frames shall be of sufficient strength to withstand a design wind load of 30 pounds per square foot of supported area with a deflection of not more than 1/175 times the length of the member. Doors shall be tested in accordance with ASTM E 330 at a pressure not less than 1.5 times the design load.

## 1.3.2 Water Penetration Performance

Frames and fixed areas, and non-handicap complying doors shall have no water penetration when tested in accordance with ASTM E 331 at a pressure of 8 psf.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTALS

## PROCEDURES:

## SD-01 Data

Aluminum Doors and Frames; GA.

Manufacturer's descriptive data and catalog cuts including air-infiltration data.

## SD-04 Drawings

Aluminum Doors and Frames; GA.

A schedule showing the location of each door shall be included with the drawings. Drawings showing elevations of each door and frame type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, and details of joints and connections.

## SD-06 Instructions

Installation; FIO. Cleaning; FIO.

Manufacturer's installation instructions and cleaning instructions.

## SD-09 Reports

Aluminum Doors; GA.

For full-glazed doors, certified test reports from an independent testing laboratory, stating that doors are identical in design, materials, and construction to a door that has been tested and meets all test and specified requirements.

## SD-14 Samples

Finishes; GA.

Samples of the color anodized coating, showing the extreme color range.

## 1.5 DELIVERY AND STORAGE

Materials delivered to the jobsite shall be inspected for damage, and shall be unloaded with a minimum of handling. Storage shall be in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy access for inspecting and handling. Materials shall be neatly stored on the floor, properly stacked on nonabsorptive strips or wood platforms. Doors and frames shall not be covered with tarps, polyethylene film, or similar coverings.

## 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

## PART 2 PRODUCTS

## 2.1 ALUMINUM DOORS AND FRAMES

Extrusions shall comply with ASTM B 221, Alloy 6063-T5 or -T6, except alloy used for anodized color coatings shall be required to produce the specified color. Aluminum sheets and strips shall comply with ASTM B 209, alloy and temper best suited for the purpose. Fasteners shall be hard aluminum or stainless steel.

### 2.1.1 Finishes

Finish shall be clear anodized. Clear anodized finish shall be AA-M10C22A41.

### 2.1.2 Welding and Fastening

Where possible, welds shall be located on unexposed surfaces. Welds required on exposed surfaces shall be smoothly dressed. Welding shall produce a uniform texture and color in the finished work, free of flux and spatter. Exposed screws or bolts will be permitted only at inconspicuous locations and shall have heads countersunk.

### 2.1.3 Anchors

Anchors shall be stainless steel or steel with a hot-dipped galvanized finish. Anchors of the sizes and shapes required shall be provided for securing aluminum frames to adjacent construction. Anchors shall be placed near top and bottom of each jamb and at intermediate points not more than 25 inches apart. Door frames free of window wall system shall be reinforced and securely anchored to floor construction.

### 2.1.4 Hardware

Hardware for aluminum doors is specified in Section 08700 BUILDERS' HARDWARE. Doors and frames shall be cut, reinforced, drilled, and tapped at the factory to receive template hardware. Reinforcement shall be provided in the core of doors as required to receive locks, door closers, and other hardware. Doors to receive surface applied hardware shall be reinforced as required.

### 2.1.5 Glazing

Glazing shall be as specified in Section 08840 PLASTIC GLAZING. Metal glazing beads, vinyl inserts, and glazing gaskets shall be provided for securing glazing. Glazing stops shall be tamperproof on exterior side.

### 2.1.6 Weatherstripping

Weatherstripping shall be continuous silicone-treated wool pile type, or a type recommended by the door manufacturer and shall be provided on head and jamb of exterior door frames. Weatherstripping for bottom of doors shall be as shown. Weatherstripping shall be easily replaced without special tools, and shall be adjustable at meeting stiles of pairs of doors. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

## 2.2 ALUMINUM FRAMES

Frames shall be non-glazed for doors only. Frames shall be fabricated of extruded aluminum shapes to contours as shown on the drawings. Shapes shown are representations of design, function, and required profile. Dimensions shown are minimum. Shapes of equivalent design may be submitted, subject to approval of samples. Minimum metal wall thickness shall be 0.090 inch, except glazing beads, moldings, and trim shall be not less than 0.050 inch. Joints in frame members shall be milled to a hairline tight fit so that raw edges of the assembly are not visible, sealed internally to prevent water infiltration, reinforced, and secured mechanically by appropriate screws or by screw spline attachment.

## 2.3 ALUMINUM DOORS

Doors shall be not less than 1-3/4 inches thick. Clearances at hinge stiles, lock stiles and top rails, floors and thresholds, shall comply with

manufacturer's standard. Single-acting doors shall be beveled 1/8 inch at lock and meeting stile edges.

#### 2.3.1 Full-Glazed Stile and Rail Doors

Doors shall have medium stiles and rails as shown, and shall be fabricated from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Top and bottom rail shall be fastened together by means of welding or by 3/8 inch diameter plated tensioned steel tie rods. An adjustable mechanism shall be provided in the top rail of narrow stile doors to allow for minor clearance adjustments after installation. Extruded aluminum snap-in glazing beads shall be provided on interior side of doors. Extruded aluminum theft-proof snap-in glazing beads or fixed glazing beads shall be provided on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets, designed to receive glazing of thickness required. Glazing is specified in Section 08840 PLASTIC GLAZING.

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF DOORS, FRAMES, AND ACCESSORIES

##### 2.4 Protection of Aluminum

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods.

##### 2.4.1 Paint

Aluminum surfaces to be protected shall be solvent cleaned and given a coat of zinc-molybdate primer and one coat of aluminum paint.

##### 2.4.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and shall be cemented to the aluminum surface using a cement compatible with aluminum.

##### 2.5 Installation

Frames and framing members shall be accurately set in position to receive adjoining components. Frames shall be plumb, square, level, and in alignment, and securely anchored to adjacent construction. Metal-to-metal joints between framing members and joints between framing members and building surfaces shall be sealed as specified in Section 07900 JOINT SEALING. Doors shall be accurately hung with proper clearances, and adjusted to operate properly.

## SECTION 08210

## WOOD DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI-02 (1994) Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program

## NATIONAL WOOD WINDOW &amp; DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1-A (1993) Architectural Wood Flush Doors

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Products

Doors shall be of the type, size, and design indicated on the drawings, and shall be the standard products of manufacturers regularly engaged in the manufacture of wood doors.

## 1.2.2 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door. The identifying mark or a separate certification shall include identification of the standard on which construction of the door is based, identity of the manufacturing plant, identification of the standard under which preservative treatment, if used, was made, and identification of the doors having a Type I glue bond.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Wood Doors and Frames; GA.

Drawings indicating the location of each door, elevation of each type of door, details of construction, marks to be used to identify the doors, and location and extent of hardware blocking. Drawings shall include catalog cuts or descriptive data for doors, weatherstripping, flashing, and thresholds to be used.

## SD-06 Instructions

Wood Doors; FIO.

Manufacturers preprinted installation and touch-up instructions.

## SD-13 Certificates

Adhesives; FIO.

Certificate stating that adhesives used for proposed doors do not contain any formaldehyde.

## SD-14 Samples

Factory Coated Natural Finish; FIO.

Samples of factory applied natural finish.

## 1.4 STORAGE

Doors shall be stored in fully covered areas and protected from damage and from extremes in temperature and humidity. Doors shall be stored on supports to prevent warping or twisting, and to provide ventilation. Factory cartons or wrappers shall be kept intact until installation.

## 1.5 HARDWARE

Hardware, including weatherstripping and thresholds, is specified in Section 08700 BUILDERS' HARDWARE.

## 1.6 NOT USED

## 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

## 2.1 GENERAL FABRICATION REQUIREMENTS

## 2.1.1 Edge Sealing

Wood end-grain exposed at edges of doors shall be sealed prior to shipment.

## 2.1.2 NOT USED

## 2.1.3 Adhesives

Adhesives shall be in accordance with NWWDA I.S. 1-A, requirements for Type II Bond Doors (water-repellent) for interior doors. Adhesive for doors to receive a transparent finish shall be nonstaining. Adhesives shall contain no formaldehydes.

## 2.1.4 Prefitting

Doors shall be furnished prefitted or unfitted at the option of the Contractor.

## 2.2 FLUSH DOORS

Flush doors shall be solid core as shown and shall conform to NWWDA I.S. 1-A, except for the one year acclimatization requirement in paragraph T-2, which shall not apply. Wood doors shall be 5-ply or 7-ply construction with faces, stiles, and rails bonded to the cores.

## 2.2.1 Core Construction

## 2.2.1.1 Solid Cores

Door construction shall be glued wood block core with vertical and horizontal edges bonded to the core.

## 2.2.2 Face Panels

### 2.2.2.1 Natural Finished Wood Veneer Doors

Veneer doors to receive natural finish shall be Premium Grade, book matched red oak veneer in accordance with NWWDA I.S. 1-A. Vertical stile strips shall be selected to provide edges of the same species and/or color as the face veneer. Door finish shall be in accordance with paragraph FIELD FINISHING.

## 2.3 NOT USED

## 2.4 NOT USED

## 2.5 MOULDING AND EDGING

Moulding and edging shall be as shown. Wood species for transparent finished doors shall be compatible with veneer.

## 2.6 NOT USED

## 2.7 NOT USED

## 2.8 FINISHING

### 2.8.1 Factory Coated Natural Finish

Doors indicated to receive factory coated natural finish shall be given a transparent finish conforming to AWI-02, Section 1500, Premium Grade, medium stain, full gloss sheen, open grain effect. Finish shall be AWI factory finish system Number TR3 or TR4. Color of the natural finish shall be in accordance with Interior Finish Key STN-1. Edges of unfitted doors shall be field finished after fitting to the frames.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF DOORS

#### 3.1.1 General Use Doors

Doors shall be fit, hung, and trimmed as required. Door shall have a clearance of 1/8 inch at the sides and top and shall have a bottom clearance of 1/4 inch over thresholds and 1/2 inch at other locations unless otherwise shown. The lock edge or both edges of doors shall be beveled at the rate of 1/8 inch in 2 inches. Cuts made on the job shall be sealed immediately after cutting, using a clear varnish or sealer. Bottom of doors shall be undercut to allow clear door swing over carpeted areas. Vertical edges of doors which have not been rounded or beveled at the factory shall be eased when the doors are installed.

-- End of Section --

## SECTION 08315

## BLAST RESISTANT DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S302	(1986) Code of Standard Practice for Steel Buildings and Bridges
AISC S335	(1989) Structural Steel Buildings - Allowable Stress Design, Plastic Design
AISC S328L	(1986) Load and Resistance Factor Design Specifications for Structural Steel Buildings

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1989) Structural Steel
ASTM A 123	(1989) (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982) (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1990) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	(1990) High-Strength Bolts for Structural Steel Joints
ASTM A 563	(1990) Carbon and Alloy Steel Nuts
ASTM A 780	(1980) (R 1987) Repair of Damaged Hot-Dip Galvanized Coatings
ASTM F 436	(1990) Hardened Steel Washers
ASTM F 844	(1990) Washers, Steel, Plain (Flat) Unhardened for General Use
ASTM E 165	(1980) Practice for Liquid Penetrant Inspection Method
ASTM E 709	(1980) (R 1985) Practice for Magnetic Particle Examination

## AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1990) Structural Welding Code Steel, Twelfth Edition
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## FEDERAL SPECIFICATIONS (FS)

FS TT-P-645 (Rev. B) Primer, Paint, Zinc-Molybdate Alkyd Type

FS TT-P-664 (Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC Compliant

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-SP 6 1989 Commercial Blast Cleaning

1.2 SUBMITTALS

Submit the following shall be submitted in accordance with Section 01300 SUBMITTALS:

1.2.1 SD-04, Drawings

- a. Blast Resistant Doors Including Framing and Supports

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.2.2 SD-13 Certificates

- a. Structural Steel
- b. High Strength Bolts
- c. Welding Electrodes and Rods
- d. Track
- e. Shop Primer

1.3 QUALIFICATIONS

1.3.1 Qualification of Welders

Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.3.2 Qualification of Manufacturer and Installer

- a. Manufacturer and installation of blast resistant doors, frames and door stops shall be performed by the blast door manufacturer who shall be fully responsible for the door fabrication, erection, operating mechanisms, and performance. The manufacturer shall have at least two years of proven successful experience in the design, fabrication and installation of similar blast resistant doors. The manufacturer shall be regularly engaged in this type of work and shall have complete facilities, equipment, and technical personnel for the design, fabrication, installation and testing of complete door systems.
- b. The Contractor shall submit for approved, information to confirm that the manufacturer's qualifications are in conformance with this specification. A list of previously successfully completed installations of a similar nature indicating the name and address of the owner and dates of installation shall be included with this information.

- c. The manufacturer shall be fully responsible for furnishing and installing blast doors complete with all equipment and materials required to provide a complete installation ready to operate.

#### 1.4 DELIVERY, STORAGE, AND PROTECTION

Protection from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Structural

ASTM A 36/A 36M.

##### 2.1.1 Bolts, Nuts, and Washers

###### 2.1.1.1 Bolts

The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

- a. Anchor Bolts: ASTM A 307, Grade A.
- b. High Strength Bolts: ASTM A 325, Type 1 or 2.

###### 2.1.1.2 Nuts

ASTM A 563, Grade A, heavy hex style, except nuts under 1.5 inches may be provided in hex style.

###### 2.1.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 bolts.

##### 2.1.2 Welding Electrodes and Rods

AWS D1.1.

##### 2.1.3 Shop Primer

FS TT-P-664 or FS TT-P-645 conforming to Federal, State, and local VOC regulations. If flash rusting occurs, reclean the surface prior to application of primer.

#### 2.2 FABRICATION

##### 2.2.1 Blast Resistant Doors

Fabricate doors in accordance with the applicable provisions of AISC S335 or AISC S328L. Workmanship shall be equal to standard commercial practice in modern metal shops. Fabricate and assemble in the shop to the greatest extent possible.

###### 2.2.1.1 Welding of Steelwork

In accordance with AWS D1.1. For the doors, welding might cause serious residual stresses, therefore, Contractor shall submit for approval by the Contracting Officer a detailed sequence of the welding, amplifying the requirements given by the AWS specifications.

### 2.2.1.2 Stud Welding

In accordance with AWS D1.1. Stud manufacturer's representative shall be in attendance for welding of the studs.

### 2.2.2 Miscellaneous Accessories

#### 2.2.2.1 Weatherstripping

Weatherstripping seals shall be flap-type, two-ply, cloth-inserted neoprene or extruded, double flap, single or dual opposed solid neoprene material on vertical edges and sills. The two-ply material shall have a minimum thickness of 1/8 inch and shall be retained continuously for its full length and secured with stainless steel fasteners inches o.c. Extruded weatherstripping with heavy center section shall be attached at 6 inches o.c., but continuous bar may be omitted. Clearance between metal parts on vertical edges of leaves and between leaves and jambs which are to be weatherstripped shall be as indicated.

### 2.3 FABRICATION FINISHES

#### 2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123 or ASTM A 153.

#### 2.3.2 Galvanize

Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces in which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

#### 2.3.4 Shop Cleaning and Painting

##### 2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC-SP 6. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.

##### 2.3.4.2 Pretreatment, Priming and Painting

Apply pretreatment and primer in accordance with manufacturer's printed instructions. Painting to be in accordance with Section 09900.

### PART 3 EXECUTION

#### 3.1 ERECTION

##### 3.1.1 Procedure

Erect in accordance with the AISC S335 or AISC S328L. Use erecting equipment suitable for the work and in first class condition. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Contracting Officer and obtain approval of the method of correction; make the correction in his presence. The straightening of plates and angles or other shapes shall be done by the methods approved by the Contracting Officer. If heating of metal is approved for straightening, it shall not be to a higher temperature than that producing a dark "cherry red" color. After heating, the metal shall be cooled as slowly as possible. There shall be no evidence of fracture on the surface of the metal after straightening. Drain steelwork properly; fill pockets exposed to the weather with an approved waterproof material.

### 3.1.2 Connections

Provide anchor bolts and other connections between the steel and concrete and properly locate and build into connecting work. Design connections for which details are not indicated in accordance with AISC S335 or AISC S328L.

### 3.1.3 High-Strength Bolting

Specification for structural joints using ASTM A 325 bolts, approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation shall govern the furnishing and installation of high-strength bolting, with the following modifications. Alternate fasteners, specified in paragraph 2(d) will not be permitted.

### 3.1.4 Erection Tolerances

In accordance with the AISC S302.

### 3.1.5 Temporary Welds and Backing Strips

Temporary Welds and Backing Strips shall be removed.

### 3.1.6 Field Painting

All exposed surfaces of the steelwork including the blast-resistant doors shall be field painted as specified in Section 09900, "Painting."

## 3.2 FIELD INSPECTION AND TESTS

### 3.2.1 Inspection

The manufacturer of the doors shall provide a field inspection engineer to perform the following:

- a. Check installation of embedded items before pouring of concrete (after forms or shoring are in place) to insure that the dimensional tolerances recommended by door manufacturer have been complied with.
- b. Re-check embedded items to verify the accuracy of dimensions after shoring and forms are removed from concrete.
- c. Supervise any necessary corrective action.
- d. Supervise the job site assembly and installation of the doors and operators.
- e. Inspect final assembly of doors and operators after corrections and adjustments have been made to doors, seals, and when doors are ready to be operated.

### 3.2.2 Visual Inspection of Welding

Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and thoroughly clean them before the inspector makes the check inspection. Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slab inclusions; excessive roughness, unfilled craters, gas pockets, undercuts, overlaps, size and insufficient throat and concavity. Inspect the preparation of groove welds for adequate throat opening and for snug position of back-up-bars.

### 3.2.3 Nondestructive Testing of Fillet Welds

Welds connecting structural steel members shall be inspected and tested over their entire length in accordance with the weld quality and standards of acceptance of AWS D1.1. Fillet welds shall be inspected by one of the following:

#### 3.2.3.1 Magnetic Particle Inspection

Methods shall be in accordance with ASTM E 709.

#### 3.2.3.2 Liquid Penetrant Inspection

Methods shall be in accordance with ASTM E 165.

### 3.2.4 Penetrant Welds

All full or partial penetration welds, shall be subjected to 100 percent ultrasonic examination. All penetrant joints shall be considered to be tension joints. All testing shall be performed by a testing laboratory approved by the Government. The testing laboratory shall be responsible for interpretation of the testing, which shall be certified and submitted in a written report for each test. In addition to the weld examination performed by the Contractor, the Contracting Officer reserved the right to perform independent examination of any welds at any time. Except for material handling assistance, the cost of all Government examination will be borne by the Government.

#### 3.2.4.1 Ultrasonic Inspection of Penetrant Welds

Technique and standards of acceptance shall be in accordance with AWS D1.1.

## 3.3 STEEL DOORS

### 3.3.1 Operation

Doors shall be manually operated by a spur gear hand chain operator. Operation shall be by pulling on an endless chain through a stationary gearbox with maximum 18-pound pull to move the door. Gear reduction ratio shall be 4.4 to 1 or less. The door operator shall not include a clutch. The hand chain wheel shall be equipped with a chain guide that will permit operation of the hand chain at an angle 10 degrees out from either side of the chain wheel without stripping or jumping the wheel rim. All load carrying parts of the operator shall resist, without damage or permanent deformation, a load of 400 pounds applied vertically to either side of the hand chain while the door is restrained from moving. The door operator shall be equipped with a manual emergency chain release which will release the door from the drive chain. The drive chain will remain intact with the emergency chain release engaged or disengaged. The emergency chain release shall be located as indicated on the drawing. The door shall be provided with a latching mechanism to secure the release both in the engaged and in the disengaged positions. A bolt and nut type locking mechanism will not be acceptable.

### 3.3.2 Door Trolleys

Trolleys shall have sealed ball bearings and shall be designed to ensure ease of operation and uniform loading of wheels. Side plates shall be of malleable iron and shall be connected to each other with at least two through-bolts in addition to the yoke connection.

-- End of Section --

## SECTION 08330

## OVERHEAD ROLLING DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 330	(1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Fundament HDBK-IP	(1997) Handbook, Fundamentals I-P Edition
ASHRAE Fundament HDBK-SI	(1997) Handbook, Fundamentals SI Edition

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993; Rev 1, Rev 2, Rev 3) Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata 96-4) National Electrical Code
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## 1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing

company certifying that the door and operator have been designed to meet the specified requirements.

#### 1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 30 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load.

The door shall support the superimposed loads for a minimum period of 10 seconds without evidence of serious damage and shall be operable after conclusion of the tests. Test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. The uniform static load test specimen shall be supported using guides, endlocks, and windlocks as required for project installation.

Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed.

#### 1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per hour. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Overhead Rolling Door Unit; GA.

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

#### SD-04 Drawings

Overhead Rolling Door Unit; GA.

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

#### SD-06 Instructions

Overhead Rolling Door Unit; FIO.

Manufacturer's preprinted installation instructions.

#### SD-09 Reports

Tests; FIO.

Windload test data.

#### SD-14 Samples

Overhead Rolling Door Unit; GA.

Manufacturer's standard color samples of factory applied finishes.

#### SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Maintenance and Repair Manual ; FIO.

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

### 1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

### 1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

## PART 2 PRODUCTS

### 2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls as indicated.

#### 2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0269 inches. Steel slats for doors from 15 feet wide to 21 feet wide shall be minimum bare metal thickness of 0.0329 inches. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

##### 2.1.1.1 NOT USED

##### 2.1.1.2 Insulated Curtains

The slat system shall supply a minimum R-value of 4 when calculated in accordance with ASHRAE Fundament HDBK-IP ASHRAE Fundament HDBK-SI. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a urethane core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as

specified for curtains. Interior face shall be not lighter than 0.0209 inches. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

#### 2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have steel endlocks of manufacturer's stock design. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.]

#### 2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors. A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

#### 2.1.4 Guides

Guides shall be steel structural shapes of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

#### 2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe.

#### 2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

#### 2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

#### 2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.0209 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

#### 2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

## 2.1.10 NOT USED

## 2.1.11 Operation

Doors shall be operated by means of electric power with auxiliary chain hoist. Equipment shall be designed and manufactured for usage in hazardous Class II, Division 1 Areas.

## 2.1.11.1 NOT USED

## 2.1.11.2 NOT USED

## 2.1.11.3 NOT USED

## 2.1.11.4 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, necessary means of reduction for medium-duty doors, self-locking worm gear in oil bath for heavy-duty doors, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate emergency manual operation of the door in case of electrical failure. Auxiliary operation shall be by means of bronze (in hazardous areas) endless chain extending to within 3 feet of the floor. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient horsepower and torque output to move the door in either direction from any position at a speed range of 6 to 8 inches per second without exceeding the rated capacity. Motors shall be suitable for operation on 208 volts, 60 hertz, 3-phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, in accordance with NFPA 70. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. Each control station shall be of the three position button type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the constant pressure type. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have an electric sensing edge for hazardous areas that will reverse the door movement upon contact with an obstruction and cause the

door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

#### 2.1.12 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.

#### 2.1.13 Locking

Locking for motor operated doors shall consist of self-locking gearing with chain lock for emergency hand chain.

#### 2.1.14 Finish

Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on finish coat. The paint system shall withstand a minimum of 1500 hours without blistering, bubbling, or rust. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be sandstone.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

-- End of Section --

SECTION 08520  
ALUMINUM WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980; R 1993) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA AAMA/NWWDA 101 I.S.2 (1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

ASTM E 547 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1997; Errata 97-1) Life Safety Code

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA ANSI/SMA 1004 (1987) Aluminum Tubular Frame Screens for Windows

1.2 WINDOW PERFORMANCE

Aluminum windows shall be designed to meet the following performance

requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

#### 1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA AAMA/NWWDA 101 I.S.2 for the window types and classification specified in this section.

#### 1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA AAMA/NWWDA 101 I.S.2 for each window type when tested in accordance with ASTM E 283.

#### 1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA AAMA/NWWDA 101 I.S.2 for each window type when tested in accordance with ASTM E 547.

#### 1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows shall not exceed R-Value Class R3.33.

#### 1.2.5 Life Safety Criteria

Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Aluminum Windows; GA.

Manufacturer's descriptive data and catalog cut sheets.

#### SD-04 Drawings

Aluminum Windows; GA. Insect Screens; GA.

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, and window schedules showing locations of each window type.

#### SD-06 Instructions

Aluminum Windows; FIO.

Manufacturer's preprinted installation instructions and cleaning

instructions.

#### SD-09 Reports

Aluminum Windows; GA.

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

#### SD-13 Certificates

Aluminum Windows; GA.

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates.

#### SD-14 Samples

Aluminum Windows; GA.

Manufacturer's standard color samples of the specified finishes.

### 1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

### 1.5 NOT USED

### 1.6 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glazing, frame, weatherstripping, screens, and hardware. Windows shall conform to AAMA AAMA/NWWDA 101 I.S.2. Windows shall be pre-glazed with 1" heavy-duty insulated triple wall extruded polycarbonate structural sheet..

#### 2.1.1 NOT USED

#### 2.1.2 Casement Windows

Aluminum casement (C) windows shall conform to AAMA AAMA/NWWDA 101 I.S.2 Designation C-HC40 type with ventilators which swing on side jamb. Hinges shall be butt (close-up) type. Operators shall be roto-type. Locking devices shall be provided to secure ventilators tightly in the frame in the closed position.

### 2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA AAMA/NWWDA 101 I.S.2, and shall be manufactured of material compatible with aluminum and resistant to weather.

Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

### 2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design. Insect screens shall be fabricated of roll-formed tubular-shaped aluminum frames conforming to SMA ANSI/SMA 1004 and (18 x 16) aluminum mesh screening conforming with ISWA IWS 089, Type III.

### 2.4 ACCESSORIES

#### 2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, stainless steel, cadmium-plated steel, nickel/chrome-plated steel in compliance with AAMA AAMA/NWWDA 101 I.S.2. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

#### 2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel in accordance with requirements established by AAMA AAMA/NWWDA 101 I.S.2.

#### 2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA AAMA/NWWDA 101 I.S.2.

### 2.5 GLAZING

Units shall be complete with glazing to meet AAMA AAMA/NWWDA 101 I.S.2. Glazing material shall be compatible with aluminum, and shall not require painting.

### 2.6 FINISH

#### 2.6.1 Anodized Aluminum Finish

Exposed surfaces of aluminum windows shall be finished with anodic coating conforming to AA DAF-45: Architectural Class I, AA-M10-C22-A41, clear anodic coating, 0.7 mil or thicker, 215-R1 Natural Color. Finish shall be free of scratches and other blemishes.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA AAMA/NWWDA 101 I.S.2. The completed window installation shall be watertight in accordance with Section 07900 JOINT SEALING. Glazing shall be installed in accordance with requirements of this section and Section

08810 GLASS AND GLAZING.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glazing shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glazing surfaces.

-- End of Section --

SECTION 08700  
BUILDERS' HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |   |
|------------|---|
| ASTM E 283 | (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen |
| ASTM F 883 | (1990) Padlocks   |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

- |                        |  |
|------------------------|--|
| BHMA-01                | (Effective thru Jun 1998) Directory of Certified Locks & Latches |
| BHMA-02                | (Effective thru Jul 1997) Directory of Certified Door Closers    |
| BHMA-03                | (Effective thru Jul 1997) Directory of Certified Exit Devices    |
| BHMA ANSI/BHMA A156.1  | (1997) Butts and Hinges  |
| BHMA ANSI/BHMA A156.2  | (1996) Bored and Preassembled Locks and Latches                  |
| BHMA ANSI/BHMA A156.3  | (1994) Exit Devices  |
| BHMA ANSI/BHMA A156.4  | (1992) Door Controls - Closers                                   |
| BHMA ANSI/BHMA A156.5  | (1992) Auxiliary Locks & Associated Products                     |
| BHMA ANSI/BHMA A156.6  | (1994) Architectural Door Trim                                   |
| BHMA ANSI/BHMA A156.7  | (1988) Template Hinge Dimensions                                 |
| BHMA ANSI/BHMA A156.8  | (1994) Door Controls - Overhead Stops and Holders                |
| BHMA ANSI/BHMA A156.13 | (1994) Mortise Locks & Latches                                   |
| BHMA ANSI/BHMA A156.16 | (1989) Auxiliary Hardware  |
| BHMA ANSI/BHMA A156.18 | (1993) Materials and Finishes                                    |
| BHMA ANSI/BHMA A156.20 | (1996) Strap and Tee Hinges and Hasps                            |
| BHMA ANSI/BHMA A156.21 | (1996) Thresholds  |

## DOOR AND HARDWARE INSTITUTE (DHI)

DHI-03 (1989) Keying Systems and Nomenclature

DHI-04 (1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames

DHI 05 (1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

DHI-A115.1G (1994) Installation Guide for Doors and Hardware

DHI A115-W (Varies) Wood Door Hardware Standards (Incl A115-W1 thru A115-W9)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1997; Errata 97-1) Life Safety Code

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Hardware and Accessories; GA.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, after approval of the detail drawings, and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

## SD-04 Drawings

Hardware Devices; GA.

Detail drawings for hardware devices for computerized keying systems, magnetic cards, keyless push button access control systems, and other electrical hardware devices showing complete wiring and schematic diagrams and other details required to demonstrate proper function of units.

## SD-07 Schedules

Hardware Schedule; GA.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule; GA.

Keying schedule developed in accordance with DHI-03, after the keying meeting with the user.

### SD-13 Certificates

Hardware and Accessories; FIO.

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA-01, BHMA-02 and BHMA-03 directories of certified products may be submitted in lieu of certificates.

#### 1.3 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

#### 1.5 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

#### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

#### 1.7 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided.

### PART 2 PRODUCTS

#### 2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

#### 2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA ANSI/BHMA A156.7.

## 2.3 HINGES

Hinges shall conform to BHMA ANSI/BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA ANSI/BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

### 2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

### 2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 101.

## 2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks, and all components thereof, including cylinders and removable cores, shall be the products of a single manufacturer. Lock fronts for double-acting doors shall be rounded. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes.

### 2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA ANSI/BHMA A156.13, operational Grade 1. Mortise type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

### 2.4.2 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA ANSI/BHMA A156.2, Grade 1. Bored type locks and latches for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

### 2.4.3 NOT USED

### 2.4.4 Auxiliary Locks and Associated Products

Bored and mortise dead locks and dead latches, narrow style dead locks and dead latches, rim latches, dead latches, and dead bolts, and electric strikes shall conform to BHMA ANSI/BHMA A156.5. Bolt and latch retraction shall be dead bolt style. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

### 2.4.5 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA ANSI/BHMA A156.5. Lock cylinder shall have not less than seven pins. Cylinders shall have key removable type cores. A grand master keying system shall be provided. Construction interchangeable cores shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, lockable exit devices, and padlocks shall accept same interchangeable cores.

### 2.4.6 NOT USED

### 2.4.7 Padlocks

Padlocks shall conform to ASTM F 883. Straps, tee hinges, and hasps shall conform to BHMA ANSI/BHMA A156.20.

#### 2.4.8 Push/Pull Latches

#### 2.4.9 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA ANSI/BHMA A156.2 or BHMA ANSI/BHMA A156.13, knobs, lever handles, roses, and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick. Knob diameter shall be 2-1/8 to 2-1/4 inches. Lever handles shall be of plain design with ends returned to no more than 1/2 inch from the door face.

### 2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA ANSI/BHMA A156.3, Grade 1.

#### 2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars shall be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons shall be cut to suit cylinders and operating trim.

#### 2.5.2 Door Coordinator

Door coordinator with carry bar shall be Type 21 and shall be provided for each pair of doors equipped with an overlapping astragal. The coordinator may be gravity operated and shall be capable of holding the active door of a pair open until the inactive door has preceded it in the closing cycle. When used as fire exit hardware, the coordinator and carry bar shall be listed or labeled by a nationally recognized independent testing laboratory.

### 2.6 NOT USED

### 2.7 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	3 change keys each lock.
Grand master keys:	2 total.
Control keys:	2 total.
Construction keys:	2 total.
Blank keys:	10 total.

The keys shall be furnished to the Contracting Officer arranged in a container in sets or subsets as scheduled.

### 2.8 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA ANSI/BHMA A156.4, Grade 1.

Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 lbf applied at the latch stile or exceed 5 lbf where low opening resistance is scheduled.

#### 2.8.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Standard Cover with options PT-4H, Size 1 or 2 through Size 6, and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

#### 2.9 DOOR CONTROLS - OVERHEAD HOLDERS

Door controls - overhead holders shall conform to BHMA ANSI/BHMA A156.8.

#### 2.10 NOT USED

#### 2.11 NOT USED

#### 2.12 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA ANSI/BHMA A156.6.

##### 2.12.1 Door Protection Plates

###### 2.12.1.1 NOT USED

###### 2.12.1.2 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. Height shall be 12 inches, except where the bottom rail is less than 12 inches the plate shall extend to within 1/2 inch of the panel mold or glass bead. Edges of metal plates shall be beveled.

###### 2.12.2 NOT USED

##### 2.12.3 Push Plates

###### 2.12.3.1 Combination Push-Pull Plates

Combination push-pull plates shall be Type J303, 0.050 inch thick minimum stainless steel beveled four edges.

###### 2.12.3.2 Flat Plates

Flat plates shall be Type J301 0.50 inch thick stainless steel, size 4 X 12". Edges of metal plates shall be beveled.

##### 2.12.4 Door Pulls and Push/Pull Units

###### 2.12.4.1 NOT USED

###### 2.12.4.2 NOT USED

###### 2.12.4.3 Door Pulls

Door pulls shall be Category J400 stainless steel of plain modern design. Pulls for hollow metal, mineral core wood or kalamein doors shall be Type J405 thru-bolted to Type J301 flat push plates.

## 2.13 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door holders and door stops shall conform to BHMA ANSI/BHMA A156.16. Lever extension flush bolts shall be Type L14081. Dust-proof strikes shall be Type L04011 for doors that are not fire rated.

## 2.14 MISCELLANEOUS

### 2.14.1 NOT USED

### 2.14.2 Metal Thresholds

Thresholds shall conform to BHMA ANSI/BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Thresholds for use with floor closers shall conform to BHMA ANSI/BHMA A156.4. Latching thresholds shall be of such height that the bottom of the door shall be 1/8 inch over the tread of the threshold and 1/8 inch below the top of the stop. Where required, thresholds shall be modified to receive projecting bolts of flush bolts, exit devices. Thresholds for doors accessible to the handicapped shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 1/2 inch. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

### 2.14.3 Rain Drips

Extruded aluminum, not less than 0.07 inch thick, painted. Door sill rain drips shall be 1-1/2 inches to 1-3/4 inches high by 5/8 inch projection. Overhead rain drips shall be approximately 1-1/2 inches high by 2-1/2 inches projection and shall extend 2 inches on either side of the door opening width.

### 2.14.4 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be clear (natural) anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

### 2.14.5 NOT USED

### 2.14.6 Key Control Storage System

Key control storage system shall conform to BHMA ANSI/BHMA A156.5, Type shall be properly labeled for key identification. Set up, identification labeling and location of the key control storage shall be as directed at the Predelivery Conference.

### 2.14.7 Door Stops

Wall stops, floor stops and combination stop and holders shall conform to BHMA ANSI/BHMA A156.16.

## 2.15 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed

to the weather in the finished work shall be of brass, bronze, or stainless steel. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws. Screws for the jamb leaf of half-mortise and full-surface hinges attached to structural steel frames shall be one-way or other approved tamperproof type.

## 2.16 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA ANSI/BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

## PART 3 EXECUTION

### 3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI 05, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-A115.1G or DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses.

#### 3.1.1 NOT USED

#### 3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

#### 3.1.3 Key Control Storage Systems

Key control storage system shall be furnished to the Contracting Officer.

#### 3.1.4 Kick Plates and Mop Plates

Kick plates shall be installed on the push side of single-acting doors and on both sides of double-acting doors. Mop plates shall be installed on the pull side of the single acting doors.

#### 3.1.5 Auxiliary Hardware

Lever extension flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. The bottom bolt shall operate into a dust-proof floor strike or threshold.

#### 3.1.6 Thresholds

Thresholds shall be secured with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inch thread engagement into the floor or anchoring device used.

## 3.1.7 Rain Drips

Door sill rain drips shall align with the bottom edge of the door.  
Overhead rain drips shall align with bottom edge of door frame rabbet.  
Drips shall be set in sealant and fastened with stainless steel screws.

## 3.1.8 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

## 3.2 NOT USED

## 3.3 FIELD QUALITY CONTROL

Supplier shall inspect the completed installation and certify that the hardware has been furnished and installed in accordance with the manufacturers' instructions and as specified. The inspection report shall identify any malfunctioning items and recommend adjustment or replacement as appropriate.

## 3.4 HARDWARE SETS

## INSPECTION BUILDING

## Hardware Set No. 1

Door Nos. 101A, 101C, 102A, 102C, 103A, 103C

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Exit Device	Type 3, Function 08 (Lever Handle) x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Cylinder	E59211A x US32D
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

## Hardware Set No. 2

Door No. 104A

3 Pr. Hinges	A5111 x US32D
1 Ea. Threshold	J32130 x 6'-0" W
2 Sets Weatherstrip	As Specified
1 Ea. Lockset	F40 x US32D (Kurlled Knob)
1 Ea. Flushbolt	L04161 x US32D
1 Ea. Footbolt	L01421 x US32D
1 Ea. Overhead Holder	C02511 x US32D
1 Ea. Closer W/Hold Open Arm	C02051 x US32D

NOTE: Active leaf latches and locks to inactive leaf. Provide closer on active leaf. Provide flushbolts on inactive leaf. Provide overhead holder on inactive leaf. Provide door coordinator as required.

NOTE: Inspection Building is Div. II, Class I Hazard Rating. All hardware shall meet explosion resistant requirements for Div. II, Class I Rating.

## RESIDUE TURN-IN BUILDING

## Hardware Set No. 1

Door Nos. 101A, 102A, 102B, 102C, 102F, 102G, 101B

1 1/2 Pr. Hinges	A5111 x US32D
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1 Ea. Exit Device	Type 3, Function 08 (Lever Handle) x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Cylinder	E59211A x US32D
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

Hardware Set No. 2

Door No. 105A

3 Pr. Hinges	A5111 x US32D
1 Ea. Threshold	J32130 x 6'-0" W
2 Sets Weatherstrip	As Specified
1 Ea. Lockset	F40 x US32D (Knurled Knob)
1 Ea. Flushbolt	L04161 x US32D
1 Ea. Footbolt	L01421 x US32D
1 Ea. Overhead Holder	C02511 x US32D
1 Ea. Closer W/Hold Open Arm	C02051 x US32D

NOTE: Active leaf latches and locks to inactive leaf. Provide closer on active leaf. Provide flushbolts on inactive leaf. Provide overhead holder on inactive leaf. Provide door coordinator as required.

Hardware Set No. 3

Door No. 104A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Kickplate	J102 x 10" X US32D
1 Ea. Pushplate	J301 x US32D
1 Ea. Pull	J401 x US32D
1 Ea. Dead Lock	E0221 x US32D
1 Ea. Wall Bumper	L02251 x US32D

Hardware Set No. 4

Door No. 103A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Wall Bumper	L02251 x US32D
1 Ea. Lockset	F42 x US32D

Hardware Set No. 5

Hinged Caging Doors

Provide 1 1/2 pair butt hinges riveted or welded to door frame and mortise type cylinder lockset with lever handles. Provide lockset with function F42 and lever handles. Align bottom of door with bottom of adjacent panels.

OPERATIONS BUILDING

Hardware Set No. 1

Door Nos. 101A, 102A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Wall Bumper	L02251 x US32D
1 Ea. Lockset	F42 x US32D

Hardware Set No. 2

## Door No. 107A, 106A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Kickplate	J102 x 10" X US32D
1 Ea. Pushplate	J301 x US32D
1 Ea. Pull	J401 x US32D
1 Ea. Dead Lock	E0221 x US32D
1 Ea. Wall Bumper	L02251 x US32D

## Hardware Set No. 3

## Door No. 105A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Threshold	J32130 x 3'-0" W
1 Set Weatherstrip	As Specified
1 Ea. Lockset	F40 x US32D (Knurled Knob)
1 Ea. Closer W/Hold Open Arm	C02051 x US32D

## Hardware Set No. 4

## Door No. 104A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Lockset	F42 x US32D

## Hardware Set No. 5

## Door Nos. 103A, 103B

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Exit Device	Type 3, Function 08 (Lever Handle) x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Cylinder	E59211A x US32D
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

## PUMPHOUSE

## Hardware Set No. 1

## Door No. 101A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Closer W/Hold Open Arm	C02061 x US32D
1 Ea. Lockset	F40 x US32D (Knurled Knob)
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

-- End of Section --

SECTION 08840  
PLASTIC GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 669 (1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash

ASTM C 920 (1995) Elastomeric Joint Sealants

1.2 GENERAL REQUIREMENTS

Plastic glazing shall be provided in the locations indicated. Glazing may be performed in the shop or in the field using plastic sheets of the thickness specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Glazing Materials; GA. Cleaning; FIO.

Data composed of catalog cuts, brochures, cleaning directions, and compatible cleaning agents.

SD-06 Instructions

Installation; FIO.

Manufacturer's installation instructions.

SD-13 Certificates

Glazing Materials; GA.

Certificates stating that the plastic sheets and glazing material meet the specified requirements.

SD-14 Samples

Plastic Sheets; GA. Glazing Compound; GA. Glazing Tape; GA. Sealant; GA.

Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 inches.

#### 1.4 DELIVERY AND STORAGE

Glazing compounds, sealants and primers shall be delivered to the site in the manufacturer's unopened containers. Plastic sheets shall be stored in safe, dry locations and shall not be unpacked until needed for installation.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Plastic Sheets

###### 2.1.1.1 NOT USED

###### 2.1.1.2 Polycarbonate Plastic Sheets

Polycarbonate structured plastic sheets shall conform to ANSI Z97.1, clear and smooth on both sides, ultraviolet stabilized, scratch resistant, 1 inch heavy-duty insulated triple wall configuration for exterior glazing and 1/4" regular configuration for interior glazing.

###### 2.1.2 Glazing Compound

Nonhardening glazing compound shall conform to ASTM C 669, gray or neutral color for glazing in wood, steel, or color finished aluminum, and aluminum color for glazing in natural colored aluminum.

###### 2.1.3 Glazing Tape

Glazing tape shall be fully-cured synthetic rubber, or plastic composition; and shall be unreinforced, 100 percent solid, resilient, nonsagging, nonstaining, and noncrazing. The tape shall be pressure sensitive. The tape shall be capable of sealing out moisture, air, and dust when compressed to the extent recommended by the glazing tape manufacturer for the extensibility requirements of the joint. The tape shall be furnished in the proper width and depth for the particular application in order to obtain the required degree of compression when installed in the joint. The tape shall withstand temperatures of minus 40 degrees F up to 160 degrees F without bleeding, cracking, flowing, or showing signs of deterioration. Tape color shall match adjacent door or window frames.

###### 2.1.4 Sealant

Sealant shall conform to ASTM C 920, Grade NS, Class 25; Use G. Sealant shall be gray or neutral color for glazing in wood, steel, or color finished aluminum, and aluminum color for glazing in natural color aluminum.

###### 2.1.5 Sealant Backstop Material

Sealant backstop shall be a material that will not adversely affect or bond with sealant. Shape and dimensions shall be as recommended by the plastic sheet manufacturer for the particular application.

###### 2.1.6 Sealant Primer

Sealant primer shall be as recommended by the sealant manufacturer.

### 2.1.7 Glazing Accessories

Glazing accessories shall be as required to supplement the items to be glazed including glazing points and spacer shims. Ferrous metal accessories shall have a finish that will not stain or corrode while in service. Spacer shims shall be of material and of dimensions recommended by the plastic sheet manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Glazing shall be performed in accordance with the approved installation instructions of the plastic sheet manufacturer.

### 3.2 CLEANING

The plastic surfaces shall be clean and free of smears, spatters, scratches, and other defacement at the time the work is accepted. Cleaning shall be in accordance with the plastic sheet manufacturer's recommendation.

-- End of Section --

SECTION 09250  
GYPSUM WALLBOARD

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580/A 580M	(1995a) Stainless Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM B 164	(1993) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM C 36	(1997) Gypsum Wallboard
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 557	(1993a) Adhesive for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630/C 630M	(1996a) Water-Resistant Gypsum Backing Board
ASTM C 645	(1996a) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 840	(1996) Application and Finishing of Gypsum Board
ASTM C 931/C 931M	(1995a) Exterior Gypsum Soffit Board
ASTM C 1002	(1996a) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM C 1047	(1995) Accessories for Gypsum Wallboard and Gypsum Veneer Base

## GYPSUM ASSOCIATION (GA)

GA 216	(1996) Application and Finishing of Gypsum Board
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## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Steel Framing; GA. Control Joints; GA.

Drawings and installation details for ceiling framing, furring, special wall framing, and framed openings in walls and ceilings.

#### SD-13 Certificates

Gypsum Wallboard; GA. Water-Resistant Gypsum Board; GA. Exterior Gypsum Soffit Board; GA. Steel Framing; GA.

Certificates stating that the steel framing and gypsum wallboard meet the specified requirements.

### 1.4 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

### 1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored off the ground in a weathertight structure for protection. Gypsum boards shall be stacked flat, off floor and supported to prevent sagging and warpage. Adhesives and joint materials shall be stored in accordance with manufacturer's printed instructions. Damaged or deteriorated materials shall be removed from jobsite.

### 1.6 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840. During the application of gypsum board without adhesive, a room temperature of not less than 40 degrees F shall be maintained. During the application of gypsum board with adhesive, a room temperature of not less than 50 degrees F shall be maintained for 48 hours prior to application and continuously afterwards until completely dry. Building spaces shall be ventilated to remove water not required for drying joint treatment materials. Drafts shall be avoided during dry hot weather to prevent materials from drying too rapidly.

## PART 2 MATERIALS

### 2.1 NON-LOADBEARING STUD WALLS

#### 2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll formed steel with minimum uncoated design thickness of 20 Ga. made from G40 hot-dip galvanized coated sheet.

#### 2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped with minimum 1 5/8 inch flanges, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

## 2.2 NOT USED

## 2.3 SUSPENDED CEILING FRAMING

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown.

The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 0.0548 in thick cold-rolled steel, 1-1/2 x 3/4 inch. Furring members shall be formed from cold-rolled steel, 7/8 x 2-9/16 inch. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

## 2.4 GYPSUM BOARD

Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length. Gypsum board thickness shall be as shown.

## 2.4.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36, and shall be 48 inches wide.

## 2.4.2 NOT USED

## 2.4.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall conform to ASTM C 630/C 630M, regular, with water-resistant paper faces, paintable surfaces, and shall be 48 inch width and maximum permissible length.

## 2.4.4 NOT USED

## 2.4.5 NOT USED

## 2.4.6 NOT USED

## 2.4.7 Exterior Gypsum Soffit Board

Exterior gypsum soffit board shall conform to ASTM C 931/C 931M, regular, 48 inches wide.

## 2.5 TRIM, MOLDINGS, AND ACCESSORIES

## 2.5.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads, and shall be compatible with tape and substrate.

## 2.5.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use as a finishing compound for gypsum board.

## 2.5.3 All-Purpose Compound

All-purpose compound shall be specifically formulated and manufactured to use as a taping and finishing compound, and shall be compatible with tape and substrate.

## 2.5.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

#### 2.5.5 Trim, Control Joints, Beads, Stops and Nosings

Items used to protect edges, corners, and to provide architectural features shall be in accordance with ASTM C 1047.

### 2.6 FASTENINGS AND ADHESIVES

#### 2.6.1 Nails

Nails shall conform to ASTM C 514. Nails shall be hard-drawn low or medium-low carbon steel, suitable for intended use.

#### 2.6.2 Screws

Screws shall conform to ASTM C 1002. Screws shall be self-drilling and self-tapping steel, Type G for gypsum board to gypsum board and Type S for wood or light-gauge steel framing.

#### 2.6.3 Adhesives

Adhesives shall conform to ASTM C 557. For securing gypsum board to metal framing, adhesive shall be as recommended by gypsum board manufacturer.

#### 2.6.4 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853 or flat iron or steel straps, at least 3/32 x 7/8 inch size, coated with zinc, cadmium, or rust-inhibiting paint.

#### 2.6.5 Wire and Clip Type Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580/A 580M, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B 164, annealed condition except that walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

##### 2.6.5.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 SWG.

##### 2.6.5.2 Clips

Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 1/8 inch thick or shall be hairpin clip, formed of wire not less than 0.01620 inch nominal diameter. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

### PART 3 EXECUTION

#### 3.1 INTERIOR WALL FRAMING

Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment with spacings not to exceed the maximum spacings indicated on drawings. Runners shall be aligned accurately at the floor and ceiling and securely anchored.

### 3.1.1 Wall Openings

The framing system shall provide for the installation and anchorage of the required subframes or finish frames for wall openings at doors, pass-through openings, and access panels. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings of more than 30 inches wide. Studs at openings shall be 0.0329 in minimum bare metal thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together with screws and secured to floor and overhead runners. Two studs shall be used for framing solid-core doors, doors over 36 inches wide and extra-heavy doors such as X-ray room doors.

### 3.1.2 Wall Control Joints

Control joints for expansion and contraction in the walls shall be constructed with double studs installed 1/2 inch apart in interior walls or wall furrings where indicated on drawings. Control joint spacing shall not exceed 30 feet. Ceiling-height door frames may be used as vertical control joints. Door frames of less than ceiling height may be used as control joints only if standard control joints extend to ceiling from both corners of top of door frame.

### 3.1.3 Blocking

Blocking shall be provided as necessary for mounted equipment. Blocking shall be wood and shall be cut to fit between framing members. Blocking shall be rigidly anchored to the framing members. Under no circumstances will accessories or other wall mounted equipment be anchored directly to gypsum wallboard.

### 3.2 NOT USED

### 3.3 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754.

#### 3.3.1 Hangers

Hangers shall be spaced not more than 48 inches along runner channels and 36 inches in the other direction or 42 inches in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 6 inches from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

#### 3.3.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 6 inches of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 12 inches with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

#### 3.3.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports

at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 2 inches of parallel walls and beams, and shall be cut 1/2 inch short of abutting walls.

### 3.3.4 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 1-1/2 inch main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

### 3.3.5 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

### 3.3.6 Control Joints

Ceiling control joints for expansion and contraction shall be located where indicated on drawings. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

#### 3.3.6.1 Interior Ceilings With Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 50 feet in either direction nor more than 2500 square feet.

#### 3.3.6.2 Interior Ceilings Without Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 30 feet in either direction nor more than 900 square feet.

#### 3.3.6.3 Exterior Ceilings

Control joints shall be installed so the linear dimensions between control joints shall not exceed 30 feet in either direction nor more than 900 square feet.

### 3.4 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840 and GA 216 and as specified. Paragraph 17.3.1 GENERAL of ASTM C 840 which permits usage of water resistant gypsum board as a base for adhesive application of ceramic or plastic tile on ceilings, does not apply. Edges and ends of gypsum boards shall be cut to obtain neat fitting joints. End joints of adjoining boards shall be staggered, and shall be staggered on opposite sides of wall. Boards shall be applied with moderate contact without forcing in place. Holes for pipes, fixtures or other small openings shall be cut with a tool which will provide a neat fit. Screws shall be driven so that the heads are slightly below the plane of paper face. Fracturing the paper face or damaging the core shall be avoided. Trim shall be installed at external and internal angles formed by the intersecting gypsum board surfaces with other surfaces. Corner beads shall be installed to vertical and horizontal corners in accordance with manufacturer's published instructions.

#### 3.4.1 NOT USED

#### 3.4.2 NOT USED

### 3.4.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall be installed at the locations indicated.

### 3.5 TRIM, MOLDINGS, AND ACCESSORIES INSTALLATION

Trim, moldings and accessories shall be installed in accordance with GA 216.

### 3.6 TAPING AND FINISHING

Gypsum board taping and finishing shall be performed in accordance with ASTM C 840. Boards shall be kept free of dirt, oil and other foreign matter that could cause a lack of bond. Screw heads, dents, gouges, and cut-outs shall be filled with joint compound and sanded. Accessories at exposed joints, edges, corners, openings, and similar locations shall be taped, floated with joint compound, and sanded to produce surfaces ready for gypsum board finishes.

### 3.7 NOT USED

### 3.8 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board smooth, uniform in appearance, and ready to receive finish as specified.

-- End of Section --

## SECTION 09310

## CERAMIC TILE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.4	(1992) Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units
ANSI A118.3	(1992) Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive
ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units
ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI A137.1	(1988) Ceramic Tile

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 241	(1990) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products

ASTM C 648	(1984; R 1994) Breaking Strength of Ceramic Tile
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1984; R 1990) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

## MARBLE INSTITUTE OF AMERICA (MIA)

MIA-01	(1991) Design Manual IV Dimensional Stone
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## TILE COUNCIL OF AMERICA (TCA)

TCA-01	(1997) Handbook for Ceramic Tile Installation
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Tile; GA. Mortar, Grout, and Adhesive; GA.

Manufacturer's catalog data.

## SD-06 Instructions

Tile; FIO. Mortar and Grout; FIO.

Manufacturers preprinted installation and cleaning instructions.

## SD-13 Certificates

Tile; GA. Mortar, Grout, and Adhesive; GA.

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

## SD-14 Samples

Tile; GA. Accessories; GA. Marble Thresholds; GA.

Samples of sufficient size to show color range, pattern, type and joints.

## 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

## 1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient

temperature is at least 50 degrees F and rising. Temperature shall be maintained above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 250 lbs for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373.

Floor tile shall have a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class IV-Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic.

##### 2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed with cushion edges. Tile size shall be 2 x 2 inches. Color shall be as indicated in the interior finish key.

##### 2.1.2 NOT USED

##### 2.1.3 NOT USED

##### 2.1.4 Glazed Wall Tile

Glazed wall tile and trim shall be cushion edged with bright glaze. Tile shall be 4-1/4 x 4-1/4 inches. Color shall be as indicated on the interior finish key.

##### 2.1.5 Accessories

Where required, accessories shall be the built-in type of the same materials and finish as the wall tile.

#### 2.2 NOT USED

#### 2.3 WATER

Water shall be potable.

#### 2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

##### 2.4.1 NOT USED

##### 2.4.2 NOT USED

##### 2.4.3 Latex-Portland Cement Mortar

ANSI A118.4.

2.4.4 Ceramic Tile Grout

ANSI A118.6; sand portland cement grout, dry-set grout.

2.4.5 Organic Adhesive

ANSI A136.1, Type I.

2.4.6 Epoxy Resin Grout

ANSI A118.3.

2.4.7 NOT USED

2.4.8 Cementitious Backer Board

Cementitious backer units shall comply with ANSI A118.9.

2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA-01. Marble shall have a fine sand-rubbed finish and shall be gray in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex portland cement mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA-01, method W223, and W242.

3.3.1 Workable or Cured Mortar Bed

Tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. A 4 mil polyethylene membrane, metal lath, and scratch coat shall also be installed. Workable mortar bed, materials, and installation of tile shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

### 3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Dry-set or Latex-portland cement shall be used to install tile in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

### 3.3.3 Organic Adhesive

Organic adhesive installation of ceramic tile shall conform to ANSI A108.4.

## 3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA-01, method F113 and G115. Shower receptors shall be installed in accordance with TCA-01, method B414 and B415.

### 3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B. Joints between quarry tile shall be between 1/4 inch and 3/8 inch in width and shall be uniform in width.

### 3.4.2 Dry-Set and Latex-Portland Cement

Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

### 3.4.3 NOT USED

### 3.4.4 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

### 3.4.5 NOT USED

### 3.4.6 NOT USED

### 3.4.7 Cementitious Backer Board

Cementitious backer units shall be installed in accordance with ANSI A108.11. Fasteners shall be type designed for cement board application.

## 3.5 NOT USED

## 3.6 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 1/4 inch in width and shall be grouted full as specified for ceramic tile.

## 3.7 NOT USED

## 3.8 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07900 JOINT SEALING.

### 3.8.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

### 3.8.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

### 3.9 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

## SECTION 09510

## ACOUSTICAL CEILINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(1995) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 1264	(1990) Standard Classification for Acoustical Ceiling Products
ASTM E 1414	(1991a) Standard Test for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

## 1.2 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. . The location and extent of acoustical treatment shall be as shown on the drawings.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Acoustical Ceiling System; GA.

Manufacturer's descriptive data, catalog cuts, and installation instructions.

## SD-04 Drawings

Acoustical Ceiling System; GA.

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

## SD-09 Reports

Ceiling Attenuation Class and Test; FIO.

Reports by an independent testing laboratory attesting that acoustical

ceiling systems meet specified sound transmission requirements.

#### SD-14 Samples

Acoustical Units; GA.

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

### 1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

### 1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

### 1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 25 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

## PART 2 PRODUCTS

### 2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

#### 2.1.1 Units for Exposed-Grid System

Type: III (mineral fiber with painted finish). Type III acoustical units shall have a minimum recycled material content of 18 percent.

Minimum NRC: 0.55 when tested on mounting No. E-400

Pattern: C.

Nominal size: 24 by 24 inches.

Edge detail: Trimmed and butt.

Finish: Factory-applied standard finish.

Minimum LR coefficient: 0.70.

Minimum CAC: 40.

## 2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than 15/16 inch. Inside and outside corner caps shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length.

## 2.3 HANGERS

Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

## 2.4 ACCESS PANELS

Access panels shall match adjacent acoustical units and shall be designed and equipped with suitable framing and fastenings for removal and replacement without damage. Panel shall be not less than 12 by 12 inches or more than 12 by 24 inches. An identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, shall be attached near one corner on the face of each access panel.

## 2.5 NOT USED

## 2.6 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

## 2.7 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as indicated on the interior room finish key..

## 2.8 CEILING ATTENUATION CLASS AND TEST

Ceiling attenuation class (CAC) range of acoustical units, when required, shall be determined in accordance with ASTM E 1414. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project. System shall be tested with all acoustical units installed.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an

object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

### 3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

#### 3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes.

#### 3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

### 3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Wall molding shall be secured not more than 3 inches from ends of each length and not more than 16 inches on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

### 3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

## 3.2 CEILING ACCESS PANELS

Ceiling access panels shall be located directly under the items which require access.

## 3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

-- End of Section --

SECTION 09650  
RESILIENT FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4078 (1992; R 1996) Water Emulsion Floor Polish  
ASTM F 1066 (1995a) Vinyl Composition Floor Tile

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Resilient Flooring and Accessories; GA.

Manufacturer's descriptive data and installation instructions including cleaning and maintenance instructions.

SD-09 Reports

Resilient Flooring and Accessories; FIO.

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified.

SD-14 Samples

Resilient Flooring and Accessories; GA.

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 2-1/2 x 4 inches.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 70 degrees F for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 70 degrees F and below 100 degrees F for 2 days before application, during application and 2 days after application. A minimum temperature of 55 degrees F shall be maintained thereafter.

### 1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

### 1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 25 tiles for each 1000 tiles installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 20 linear feet of each color shall be furnished.

## PART 2 PRODUCTS

### 2.1 VINYL-COMPOSITION TILE

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, (through pattern tile), Composition 1, asbestos-free, and shall be 12 inches square and 1/8 inch thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

### 2.2 NOT USED

### 2.3 NOT USED

### 2.4 NOT USED

### 2.5 NOT USED

### 2.6 RESILIENT BASE

Base shall be manufacturers standard rubber. Base shall be 4 inches high and a minimum 1/8 inch thick. Preformed outside and inside corners shall be furnished.

### 2.7 NOT USED

### 2.8 NOT USED

### 2.9 TRANSITION STRIP

A rubber transition strip tapered to meet abutting material shall be provided. Color shall match rubber wall base.

### 2.10 ADHESIVE

Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.

### 2.11 POLISH

Polish shall conform to ASTM D 4078.

#### 2.12 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07900 JOINT SEALING.

#### 2.13 MANUFACTURER'S COLOR AND TEXTURE

Color and texture shall be as indicated in the interior finish key.

### PART 3 EXECUTION

#### 3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

#### 3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

#### 3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

#### 3.4 INSTALLATION OF VINYL-COMPOSITION TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

#### 3.5 NOT USED

#### 3.6 NOT USED

#### 3.7 NOT USED

#### 3.8 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk.

#### 3.9 NOT USED

## 3.10 NOT USED

## 3.11 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. After installation, flooring shall be washed with a cleaning solution, rinsed thoroughly with clear cold water, and, except for raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile, given two coats of polish in accordance with manufacturers written instructions. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine. Raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile shall be cleaned and maintained as recommended by the manufacturer.

## 3.12 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled shall be removed and replaced.

-- End of Section --

## SECTION 09680

## CARPET

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC TM 16	(1993) Test Method: Colorfastness to Light
AATCC TM 134	(1991) Test Method: Electrostatic Propensity of Carpets
AATCC TM 165	(1993) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method
AATCC TM 174	(1993) Test Method: Antimicrobial Activity Assessment of Carpet

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 1423	(1992) Twist in Yarns by the Direct-Counting Method
ASTM D 3278	(1996) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E 648	(1997) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

## CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1996) Commercial Carpet Installation Standard
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## CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1630	Standard for the Surface Flammability of Carpet and Rugs (FF 1-70)
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## GERMANY INSTITUTE FOR STANDARDIZATION (DEUTSCHES INSTITUT FÜR NORMUNG) (DIN)

DIN 54318	(1986) Machine-Made Textile Floor Coverings; Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions; Identical with ISO 2551 Edition 1981
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Carpet and Accessories; GA.

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

SD-04 Drawings

Installation; GA.

Six copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-06 Instructions

Carpet and Accessories; FIO.

Six copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

SD-09 Reports

Moisture and Alkalinity Tests; FIO.

Six copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-13 Certificates

Carpet and Accessories; FIO.

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

SD-14 Samples

Carpet and Accessories; GA.

- a. Carpet: Two "Production Quality" samples 27 x 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.
- b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.
- c. Special Treatment Materials: Two samples showing system and installation method.

SD-19 Operation and Maintenance Manuals

Carpet and Accessories; GA.

Six copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning

methods, and cleaning cycles.

### 1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 60 degrees F for 2 days prior to installation.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 60 degrees F for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 55 degrees F shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

### 1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of uncut carpet tiles shall be provided for future maintenance. A minimum of 10 percent of total square yards of each carpet type, pattern, and color shall be provided.

## PART 2 PRODUCTS

### 2.1 CARPET TYPE

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance.

#### 2.1.1 Physical Characteristics

Carpet shall comply with the following:

- a. Carpet Construction: Bonded.
- b. Type: Modular tile 18 x 18 inches square with 0.15 percent growth/shrink rate in accordance with DIN 54318.
- c. Pile Type: Level-loop.
- d. Pile Fiber: 75% commercial solution dyed nylon continuous filament, 25% Dupont Antron Legacy.
- e. Pile or Wire Height: Minimum 0.117 inch in accordance with ASTM D

418.

- f. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.
- g. Gauge or Pitch: Minimum 1/13 inch in accordance with ASTM D 418.
- h. Finished Pile Yarn Weight: Minimum 20 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.
- i. Pile Density: Minimum 6154.
- j. Dye Method:

Solution dyed.

- k. Backing Materials: Primary backing materials shall be synthetic hardback. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.

#### 2.1.2 Performance Requirements

- a. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC TM 134.
- b. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648.
- c. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 9 pound average force for loop pile.
- d. Additional Performance Characteristics:
  - (1) Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC TM 174, Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.
- e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC TM 165 and shall have a minimum rating of step 4 on the AATCC Color Transference Chart for all colors.
- f. Colorfastness to Light: Colorfastness to light shall comply with AATCC TM 16 and shall have a minimum 4 grey scale rating after 40 hours.
- g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 2.5 lb./inch

#### 2.2 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as recommended by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer. Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 140 degrees F in accordance with ASTM D 3278.

## 2.3 MOLDING

Rubber vinyl molding shall be heavy-duty and designed for the type of carpet being installed. Floor flange shall be a minimum 2 inches wide. Color shall match rubber coved base.

## 2.4 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

## 2.5 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be as indicated in the interior finish key.

# PART 3 EXECUTION

## 3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

## 3.2 MOISTURE AND ALKALINITY TEST

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104. The moisture content shall not exceed a hygrometer reading of 65 percent.

## 3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

## 3.4 INSTALLATION

Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding. Installation shall be in accordance with the molding manufacturer's instructions.

### 3.4.1 NOT USED

### 3.4.2 Modular Tile Installation

Modular tiles shall be installed with release adhesive and shall be snugly jointed together. Tiles shall be laid in the same direction with accessibility to the subfloor where required.

## 3.5 CLEANING AND PROTECTION

### 3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

### 3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

### 3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total, shall be provided. Non-retained scraps shall be removed from site.

-- End of Section --

SECTION 09900  
PAINTING, GENERAL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-02 (1996) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150 (1996) Portland Cement  
ASTM D 4258 (1988; R 1992) Surface Cleaning Concrete for Coating

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500 (Rev A) Sealer, Surface (Latex Block Filler)  
CID A-A-1632 (Basic) Varnish, Asphalt  
CID A-A-2246 (Rev A) Paint, Latex (Gloss, Interior)  
CID A-A-2247 (Basic) Paint, Latex (Semigloss, Interior)  
CID A-A-2248 (Basic) Paint, Latex, (Flat, Interior)  
CID A-A-2867 (Basic) Coating, Polyurethane, Single Component Moisture Cure, Aliphatic  
CID A-A-2962 (Basic) Enamel, Alkyd  
CID A-A-2994 (Basic) Primer Coating, Interior, for Walls and Wood

## FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784 (Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 5 (1995) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint  
SSPC Paint 18 (1991) Chlorinated Rubber Intermediate Coat Paint  
SSPC Paint 23 (1982) Latex Primer for Steel surfaces  
SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead)

and Chromate Pigments)

SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Paint; GA.

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular batch is 50 gallons or less.

### SD-06 Instructions

Mixing and Thinning; FIO. Application; GA.

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings.

### SD-09 Reports

Paint; FIO.

A statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 50 gallons:

- a. A test report showing that the proposed batch to be used meets specified requirements:
- b. A test report showing that a previous batch of the same formulation as the batch to be used met specified requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per gallon, viscosity, fineness of grind, drying time, color, and gloss.

### SD-13 Certificates

Lead; FIO. Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead by weight of the total nonvolatile. Certificate stating that paints proposed for use meet Federal VOC regulations and those of the of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

### SD-14 Samples

Paint; GA.

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1 quart sample of each color and batch, except for quantities of 50 gallons or less, shall be taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.

### 1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons.

Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

### 1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

### 1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned, epoxy, and moisture-curing polyurethane coatings.

Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F. Epoxy, and moisture-curing polyurethane coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer. Moisture-curing polyurethane shall not be applied when the relative humidity is below 30 percent.

### 1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

#### 1.6.1 Worker Exposures

Exposure of workers to hazardous chemical substances shall not exceed limits established by ACGIH-02, or as required by a more stringent applicable regulation.

#### 1.6.2 Toxic Compounds

Toxic products having ineffective physiological warning properties, such as

no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

#### 1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MDSS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

#### 1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

### PART 2 PRODUCTS

#### 2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the requirements listed in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended formulation, usage and color to that specified may be used. Additional requirements are as follows:

##### 2.1.1 Colors and Tints

Colors shall be as selected from manufacturer's standard colors, as indicated. Manufacturer's standard color is for identification of color only. Tinting of epoxy paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

##### 2.1.2 NOT USED

##### 2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

##### 2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

##### 2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

### PART 3 EXECUTION

#### 3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

### 3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

#### 3.2.1 Concrete, Stucco and Masonry Surfaces

Concrete, stucco and masonry surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Surfaces shall be cleaned in accordance with ASTM D 4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat.

#### 3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

#### 3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1.

#### 3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a cloth, or vacuum-cleaning prior to application of the first-coat material. A damp cloth or sponge may be used if paint will be water-based.

#### 3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

### 3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not

relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

#### 3.3.1 Cement-Emulsion Filler Coat

Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

#### 3.3.2 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

### 3.4 APPLICATION

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

#### 3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

#### 3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

#### 3.4.3 First Coat

The first coat on plaster, gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall

be wiped off after each application. The first coat on both faces of wood doors shall be applied at essentially the same time. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around. Each varnish coat shall be sanded lightly prior to application of subsequent coats.

#### 3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

#### 3.4.5 Stains

Stain shall be applied at the rate specified in the manufacturer's printed directions. Oil-type stain shall be applied by brushing with the grain for the full length of the board or course of siding.

#### 3.4.6 Fillers

Concrete and masonry surface voids shall be filled; however, surface irregularities need not be completely filled. The dried filler shall be uniform and free of pinholes. Filler shall not be applied over caulking compound.

##### 3.4.6.1 Cement-Emulsion Filler

Immediately before filler application, surfaces shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 85 degrees F, cement-emulsion filler surfaces shall be dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

##### 3.4.6.2 Latex Filler

Latex filler, CID A-A-1500, shall be applied according to the manufacturer's instructions. Surface voids shall be filled and excess filler shall be removed from the surface with a rubber squeegee. The filler shall be allowed to dry the length of time specified by the manufacturer prior to applying successive coats of paint.

#### 3.4.7 NOT USED

#### 3.4.8 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 40 foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable) WATER	Green	White	POTABLE
Fire protection water WATER	Red	White	FIRE PR.
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Yellow	Black	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Yellow	Black	COMP. AIR
Natural gas	Blue	White	NAT. GAS
Freon	Blue	White	FREON
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STM.
Condensate	Yellow	Black	COND.

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

3.6 MISCELLANEOUS PAINTING

3.6.1 Lettering

Lettering shall be provided as scheduled on the drawings, shall be block type, and shall be black enamel. Samples shall be approved before application.

3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

3.8 NOT USED

3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by -----or----- between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Concrete masonry units.	Cement-emulsion filler	FS TT-E-2784 Type III	None
	CID A-A-1500	FS TT-E-2784 Type III	None
	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None

NOTE: Cement-emulsion filler coat shall be acrylic-based and shall consist of the following ingredients in the proportion stated: white portland cement, ASTM C 150, Type I, 16.5 pounds; aggregate 33.5 pounds; mixing liquid, factory-prepared acrylic containing 46 to 47 percent solids, 0.75 gallon; potable water 1.0 gallon maximum; exterior emulsion paint, FS TT-E-2784 Type III 1.0 gallon. Aggregate shall consist of Washed silica sand of the following gradation:

<u>U.S. Sieve Size</u>	<u>Percent Sand (by Weight) Passing Individual Sieve</u>
0.850 mm (20)	100
0.600 mm (30)	95 - 100
0.300 mm (50)	30 - 65
0.150 mm (100)	0 - 10
0.075 mm (200)	0 - 1

Concrete, unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None
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EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Concrete: walls 18 and bottom of swimming pools.	SSPC Paint 18  thin with 1 part of approved thinner to 4 parts of paint by volume	SSPC Paint 18	SSPC Paint
Ferrous metal unless otherwise	SSPC Paint 5  Grade C	CID A-A-2962 Type I specified  Grade C	CID A-A-2962 Type 1
	SSPC Paint 25	CID A-A-2962 Type I Grade C	CID A-A-2962 Type 1 Grade C
	SSPC Paint 23	FS TT-E-2784 Type I	FS TT-E-2784 Type I
Galvanized metal.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	FS TT-E-2784 Type III
Aluminum aluminum-alloy,  and other non- ferrous metal (non-galvanized)	CID A-A-2867  FS TT-E-2784 Type III	CID A-A-2867  FS TT-E-2784 Type III	None  FS TT-E-2784 Type III

INTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Gypsum board, concrete, and concrete masonry units not requiring a smooth finish, unless otherwise specified.	CID A-A-2994 Type II	CID A-A-2246	None
		-----or-----	
		CID A-A-2247	None
		-----or-----	
		CID A-A-2248	None
Concrete masonry units requiring a smooth finish	CID A-A-1500	CID A-A-2994 Type II	CID A-A-2246
			-----or-----
			CID A-A-2247
			-----or-----
			CID A-A-2248
Gypsum board: in shower areas, and areas requiring a high degree of sanitation, unless otherwise specified.	CID A-A-2994 Type II	FS TT-E-2784	None
Concrete masonry units, and gypsum board: for walls in heavy traffic areas.	CID A-A-1500	CID A-A-2994 Type II	CID A-A-2246
			-----or-----
			CID A-A-2247
Ferrous Metal unless otherwise specified	SSPC Paint 25	CID A-A-2962 Type I	CID A-A-2962 Type I
			Grade C
	SSPC Paint 23	FS TT-E-2784 Type I	FS TT-E-2784 Type I
	CID A-A-2867	CID A-A-2867	None
Aluminum and aluminum alloy	CID A-A-2867	CID A-A-2867	None

unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type I	FS TT-E-2784 Type I
Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces:	CID A-A-1632	None	None
Ferrous metal factory-primed mechanical and electrical equipment.	Two coats of paint as recommended by the equipment manufacturer		None
Galvanized metal:	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None
	SSPC Paint 5	CID A-A-2962 Type I Grade C	CID A-A-2962 Type I Grade C
	SSPC Paint 25	CID A-A-2962 Type I Grade C	CID A-A-2962 Type I Grade C
	SSPC Paint 23	FS TT-E-2784	FS TT-E-2784
Ferrous Metal: Convector enclosures, electrical conduit runs: metallic tubing uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets, in areas having painted adjacent surfaces.	SSPC Paint 23	None	None
Aluminum and Galvanized Surface Metal: Convector enclosures, electrical conduit runs metallic tubing uninsulated	FS TT-E-2784	CID A-A-2246 -----or----- CID A-A-2247 -----or----- CID A-A-2248	CID A-A-2246 -----or----- CID A-A-2247 -----or----- CID A-A-2248

ducts and pipes,  
pipe hangers,  
louvers, grilles,  
and air outlets,  
in areas having  
painted adjacent  
surfaces.

---

-- End of Section --



Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style A, floor supported. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be laminated plastic, with phenolic core, Finish 3. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 TOILET ACCESSORIES, shall be prepared for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

### 2.2 NOT USED

### 2.3 NOT USED

### 2.4 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. All hardware shall be provided for a complete installation including coat hooks, door latches, and pivots.

### 2.5 COLORS

Color of finishes for toilet partition system components shall be manufacturer's standard as indicated in the interior room finish key.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by through-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work.

### 3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

SECTION 10211

FIXED METAL WALL LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fixed louvers and frames.
- B. Insect screening.

1.2 RELATED SECTIONS

- A. Section 07600 - Sheet Metal Work, General.
- B. Section 07900 - Joint Sealers.
- C. Section 15895 - Air Supply Distribution, Ventilation, and Exhaust System.

1.3 REFERENCES

- A. AMCA 500 (Air Movement Control Association) - Test Method for Louvers, Dampers, and Shutters.
- B. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate.
- C. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- D. ASTM A527 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
- E. ASTM B209 - Aluminum-Alloy Sheet and Plate.
- F. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

1.4 PERFORMANCE REQUIREMENTS

- A. Louver: As indicated on the louver schedule.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

- A. SD-04 Shop Drawings

Metal Wall Louvers; GA.

Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

- B. SD-01 Product Data

Metal Wall Louvers; GA.

Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. SD-14 Samples

Metal Wall Louvers; GA.

Submit two samples 8 x 8 inch (203 x 203 mm) in size illustrating finish and color of exterior and interior surfaces.

D. SD-13 Manufacturer's Certificates

Metal Wall Louvers; FIO.

Certify that Products meet or exceed specified requirements

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA Certification for intake/exhaust louvers.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

- A. Coordinate the Work with installation of masonry flashings.

1.10 WARRANTY

- A. Provide twenty year warranty.  
B. Warranty: Include coverage for degradation of polyvinylidene fluoride.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B221, 6063-T5 alloy, temper; extruded shape; prefinished with shop applied fluoropolymer finish.

2.2 SCREENS

- A. Insect Screen: Aluminum mesh, set in aluminum frame.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Stainless steel type.  
B. Flashings: Of same material as louver frame. Sheet aluminum.

- C. Sealants: Exterior type specified in Section 07900.

#### 2.4 FABRICATION

- A. Louver Panel Thickness: As indicated on louver schedule.
- B. Louver Blade Design: Sloped at 45 degrees; reinforced with intermediate stiffeners, material thickness of .081 inch (2.06 mm) minimum, integral and lateral rain water stops positioned on blade.
- C. Louver Frame: Channel shape, welded corner joints, material thickness of .081 inch (2.06 mm) minimum.
- D. Intermediate Mullions: Recessed of extruded aluminum, profiled to suit louver frame.
- E. Head and Sill Flashings: Extruded to required shape, single length in one piece per location.
- F. Screens: Install screen mesh in shaped frame, reinforce corner construction, shop install to louver with fasteners.

#### 2.5 FINISHES

- A. Exterior and Interior Aluminum Surfaces, Screen. Prepainted finish of flouropolymer color as selected from manufacturers standard colors to match roof color.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Where applicable, verify that electric power is available and of the correct characteristics.

#### 3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louvers in opening framing with concealed fasteners.
- E. Install insect screen and frame to exterior of louver.
- F. Install insect screen and frame to intake louvers.
- G. Install perimeter sealant and backing rod in accordance with Section 07900.

3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION

SECTION 10440  
INTERIOR SIGNAGE

PART 1 GENERAL

1.1 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.1.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches.

1.1.2 Raised and Brailled Characters and Pictorial Symbol Signs  
(Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Interior Signage; GA.

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Drawings

Interior Signage; GA.

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-14 Samples

Interior Signage; GA.

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

- a. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

SD-19 Operation and Maintenance Manuals

Interior Signage; GA.

Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

### 1.3 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

### 1.5 EXTRA STOCK

The Contractor shall provide extra frames and extra stock of the following:  
2 blank plates of each color and size for sign types. 2  
pressure-sensitive letters in each color and size for sign type. 2  
changeable message strips for sign type.

## PART 2 PRODUCTS

### 2.1 ROOM IDENTIFICATION SIGNAGE SYSTEM

Signs shall be fabricated of Type ES/MP laminated thermosetting plastic suitable for engraving.

#### 2.1.1 Standard Room Signs

Signs shall consist of matte finish laminated thermosetting Type MP plastic. Units shall be frameless. Corners of signs shall be 1/2 inch radius.

#### 2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall consist of laminated thermosetting Type MP plastic Type MP plastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Size of signs shall be as shown on the drawings. Individual message strips to permit removal, change, and

reinsertion shall be provided. Corners of signs shall be 1/2 inch radius.

#### 2.1.3 Type of Mounting For Signs

Extruded aluminum brackets shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be provided with countersunk mounting holes in plaques and mounting screws. Sign inserts shall be provided with 1/16 inch thick foam tape.

#### 2.1.4 Graphics

Signage graphics for modular identification signs shall conform to the following:

Acrylic letters 1/8 inch thick and chemically welded to 0.125 inch thick acrylic backup sheet.

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

#### 2.8 FABRICATION AND MANUFACTURE

##### 2.8.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

##### 2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

#### 2.9 COLOR, FINISH, AND CONTRAST

Color shall be black. In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach

within 3 inches of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

## SECTION 10605

## WIRE MESH PARTITIONS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Wire mesh system for walls and ceiling.

## 1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete.
- B. Division 9 - Finishes.

## 1.3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A123 - Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- E. ASTM A446 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical Quality).
- F. ASTM A500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A501 - Hot-formed Welded and Seamless Carbon Steel Structural Tubing.
- H. ASTM A510 - General Requirements For Wire Rods and Course Round Wire, Carbon Steel.
- I. ASTM A580 - Stainless and Heat-Resisting Steel Wire.
- J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- K. ASTM B211 - Aluminum-Alloy Bars, Rods, and Wire.
- L. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- M. AWS D1.1 - Structural Welding Code.
- N. SSPC (Steel Structures Painting Council) - Painting Manual.

- 1.4 SUBMITTALS: Submit under provisions of Section 01300.

## A. SD-04 Shop Drawings

Wire Mesh Partitions; GA.

Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, framed openings, anchorage, welds, type and location of fasteners, and accessories or items required of related work.

## B. SD-01 Product Data

Wire Mesh Partitions; GA.

Mesh Partition Screen; GA.

Hardware; GA.

Provide data for screen materials, finishes, and hardware.

## C. SD-14 Samples

Wire Mesh Partition; GA.

Accessories; GA.

Submit two samples, 12" x 12" in size illustrating screen material. Submit samples of hinge latchset illustrating style, color, and finish.

Installation Instructions; FIO.

Indicate special procedures, perimeter conditions requiring special attention.

## D. SD-08 Statements

Qualifications; FIO.

## 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may

be incorporated in the work include, but are not limited to, the following:

Acorn Wire and Iron Works, Inc.  
The G-S Company  
Hoosier Fence Co., Inc.  
Indiana Wire Products, Inc.  
Kentucky Metal Products Co.  
King Wire Partitions Inc.  
Lakeside Wire and Iron Co.  
Miller wire Works, Inc.  
Wire and Iron Products, Inc.

## 2.2 HEAVY DUTY MESH PARTITIONS

- A. Mesh: 10-gage crimped steel wire woven into 1-1/2-inch diamond mesh, securely clinched to frame members.
- B. Frames: Provide cutouts for pipes, ducts, beams, and other items shown or necessary for partition installation. Finish edges of cutouts to provide a neat, protective edge.
- C. Frame Members: 1-1/4 inch by 5/8 inch cold rolled steel channels, conforming to ASTM A36, with 3/8 inch bolt holes approximately 18 inches o.c.
  - 1. Horizontal Reinforcing Members: 1-1/2 inch by 3/4 inch by 1/8 inch cold rolled steel channel with wire woven through, or two 1-inch by 1/2 inch channels bolted or riveted toe-to-toe through the mesh and secured to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.
- D. Stiffening Bars: Provide flat bar stiffener posts between all abutting panel frames. Size as recommended by partition manufacturer for partition height required. Increase size of stiffening bars if required to maintain partition rigidity.
- E. Top Capping Bars: 3 inch by 4.1 pound channel secured to top framing members with 1/4 inch "U" bolts spaced not more than 28 inches o.c.
- F. Line Posts: Where partition runs exceed 20 feet without intersection or connection to overhead framing, furnish 3 inch by 4.1 pound channel line posts with 5 inch by 18 inch by 1/4 inch base plates located at recommended intervals to ensure partition rigidity and stability.
- G. Floor Shoes: Cast metal, sized to suit vertical framing and to provide approximately 3 inches clear space between finished floor and bottom horizontal frame members. Furnish units with set screw for leveling adjustment.

### 2.3 DOORS

- A. Hinged Door: Door frame of 1-1/2" x 3/4" channel with 1-1/2 x 1/8" flat bar cover three sides. 1-5/8" x 7/8" x 1/8" angle riveted to lock side. Refer to 08700 Builder's Hardware for Cage Door Hardware.
- B. Cylinders for locks are specified in Section 08700.

### 2.4 WINDOW GUARDS

- A. Horizontal Reinforcing Members: Two 1 inch by 3/8 inch channels riveted toe-to-toe through the mesh and welded to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.
- B. Anchorage Devices: Furnish appropriate types and quantities of anchorage devices to provide adequate anchorage to adjacent structures.

### 2.5 FABRICATION

- A. Do not use components less than sizes indicated. Use larger size components as recommended by partition component manufacturer.
- B. Provide bolts, hardware, and accessories for complete installation.
- C. Finish: Manufacturer's standard shop-applied enamel finish. Provide manufacturer's standard finish color.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

### 3.2 INSTALLATION

- A. Erect partitions plumb, rigid, properly aligned, and securely fastened in place, complying with drawings and manufacturer's recommendations.
- B. Provide additional field bracing as shown or necessary for rigid, secure installation. Erector to provide additional clips and bracing as required.

- C. Installation: All bolts shall be welded or peened to eliminate removal of nuts.

3.3 ADJUST AND CLEAN

- A. Adjust moving components for smooth operation without binding.
- B. Touch-up damaged finish after completion of installation using field-applied paint to match color of shop-applied finish.

END OF SECTION

SECTION 10800  
TOILET ACCESSORIES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991) Flat Glass

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation, submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Finishes; GA. Accessory Items; GA.

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

## SD-14 Samples

Finishes; GA. Accessory Items; GA.

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

## SD-19 Operation and Maintenance Manuals

Six complete copies of maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs. Instructions shall include simplified wiring and control diagrams and other information necessary for unit maintenance.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

## 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

## 2.1 MANUFACTURED UNITS

Toilet accessories shall be provided as indicated on the drawings. Each accessory item shall be complete with the necessary mounting plates and shall be of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

2.2.1 NOT USED

2.2.2 Grab Bar (GB)

Grab bar shall be 18 gauge, 1-1/4 inches OD Type 304 stainless steel. Grab bar shall be form and length as indicated. Concealed mounting flange shall have mounting holes concealed. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 1-1/2 inch.

2.2.3 NOT USED

2.2.4 Mirrors, Glass (MG)

Glass for mirrors shall be Type I transparent flat type, Class 1-clear. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.5 NOT USED

2.2.6 NOT USED

2.2.7 NOT USED

## 2.2.8 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 18 gallons. Unit shall be fabricated of not less than 0.30 inch stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

## 2.2.9 Combination Recessed Toilet Seat Cover Dispenser, Sanitary Napkin Disposal, Toilet Tissue Dispenser

Recessed toilet-seat-cover dispenser, sanitary napkin disposal, and toilet tissue dispenser shall be type 304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Flange shall be drawn and beveled, one-piece, seamless construction. Unit shall mount flush against side wall of barrier-free toilet compartment to allow clearance for grab bar across front of unit. Door shall be one-piece, seamless construction, secured to cabinet with a full-length stainless steel piano-hinge, and equipped with a tumbler lock keyed like other Bobrick washroom accessories. Toilet-seat-cover dispenser shall fill from below the internal shelf and hold 500 paper covers. Self-closing disposal panel shall be secured to door with a spring-loaded, full-length stainless steel piano-hinge and equipped with an international graphic symbol identifying napkin disposal. Sanitary napkin disposal shall be furnished with a removable, leak-proof, molded polyethylene receptacle and shall have a capacity of 0.8 gal. (3.0L). Unit shall be equipped with two theft-resistant, high-impact polystyrene toilet tissue spindles that hold standard-core rolls up to 5-1/4" (135 mm) diameter (1800 sheets). Spindles shall be removable from cabinet when door is open; when door is closed, removal shall require a special key provided for the concealed locking mechanism in spindles.

2.2.10 NOT USED

2.2.11 NOT USED

2.2.12 NOT USED

## 2.2.13 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps. Lavatory mounted, liquid type consisting of a polyethylene tank with a minimum 32 fluid ounces holding capacity and a 6 inch spout length.

2.2.14 NOT USED

## 2.2.15 Shelf, Metal, Heavy Duty (SMHD)

Heavy duty metal shelf shall be minimum of 18 gauge stainless steel with hemmed edges. Shelves over 30 inches shall be provided with intermediate supports. Supports shall be minimum of 16 gauge, shall be welded to the shelf, and shall be spaced no more than 30 inches apart.

2.2.16 NOT USED

2.2.17 NOT USED

2.2.18 NOT USED

2.2.19 NOT USED

2.2.20 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted recess mounted with two rolls of standard tissue mounted horizontally. Cabinet shall be stainless steel, satin finish.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Toilet accessories shall be securely fastened to the supporting construction in accordance with the manufacturer's approved instructions. Accessories shall be protected from damage from the time of installation until acceptance.

#### 3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

-- End of Section --

## SECTION 11213

## PERMANENT PUMP

## PART 1 GENERAL

## 1.1 SCOPE OF WORK

This section includes all equipment, labor, materials, and appurtenances necessary to install and place into operation a submersible pump for the groundwater extractions well. The installation shall include one (1) submersible pump for the water supply well. The pump shall be driven by a motor attached below the pump section. The pump shall be furnished by one supplier, who shall be responsible for furnishing, testing, start-up, and successful operation of all of the equipment specified under this section. All work in connection with the manufacture, delivery, and installation of the equipment shall be complete so that equipment is ready for service, referred to in Section 02523 SUBMERSIBLE PUMP INSTALLATION.

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

## 1.2.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model, serial number, and catalog number on a plate secured to the item of equipment. Submersible pumps and motors shall also have identical nameplates affixed in a conspicuous place to the pumphouse wall or discharge piping. In addition, the nameplate for each pump shall show the capacity in gallons per minute at rated head in feet and speed in the revolutions per minute. Nameplate for each electric motor shall show the horsepower, speed in revolutions per minute, full load current, voltage, frequency, phases, time rating, maximum ambient temperature, insulation class code letter, and service factor.

## 1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of this work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Submersible Pump; GA.

Manufacturer's descriptive data and technical literature, performance

charts and curves, catalog cuts, and installation instructions.

Spare parts for each different item of material and equipment specified, after approval for the detail drawings no later than 1 month prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 year(s) of service.

#### SD-04 Drawings

Submersible Pump; GA.

Detail drawings consisting of equipment and materials. Detail drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

#### SD-06 Instructions

Submersible Pump; FIO.

Proposed diagrams, instructions, and other sheets prior to posting

#### SD-09 Reports

Testing; FIO.

Tests reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of the controls.

#### SD-19 Operation and Maintenance Manuals

Submersible Pump; FIO.

Six complete copies of operating manual outlining the step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include simplified wiring, layout, and control diagrams of the system as installed.

## PART 2 PRODUCTS

### 2.1 PUMP REQUIREMENTS

#### 2.1.1 Type of Installation

The work shall include furnishing, installing, and testing submersible pumps and their appurtenances as indicated. Pumps shall be utilized for potable water and fire suppression water supply and installed in the well.

#### 2.1.2 Well Data

Pumps shall be suitable for installation in the well casings and under the conditions indicated.

## 2.2 PUMP PERFORMANCE

Pumps shall be capable of discharging quantities of water at a maximum speed and total pump head with the minimum efficiency indicated. Total pump head in feet shall consist of the pumping level below the datum and the static and friction head above the datum at design capacity.

## 2.3 SUBMERSIBLE PUMP

Based on the anticipated required pump capacities and head losses, the pump units shall be a 10-hp Grundfos 85S100-8 pump model with Teflon seals or approved equal. The pump shall be designed for connection to piping as indicated. A strainer shall be provided at the pump suction. Pumps shall be operable at heads ranging from 25 percent above or below the normal design head. The pump and motor shall be at least 1 inch smaller than the inside diameter of well screen or casing, whichever is less.

### 2.3.1 Pump Head Assembly

Pump head assembly shall consist of the surface plate from which the vertical discharge pipe is suspended and an elbow or fitting (pitless adapter) as required for connecting to the piping system. Head assembly shall be provided with eyebolts, lugs, or other means of securing sling to facilitate setting and lifting.

### 2.3.2 Pump Bowl Assembly

The pump bowls, impellers, guide vanes, and filter screen shall be 300 Series stainless steel. Each impeller shall have a Teflon seal ring around its eye or skirt to reduce hydraulic losses. There shall be a Teflon shaft bearing located either above or below each impeller. A 300 Series stainless steel filter screen shall be included as part of the suction inlet assembly.

### 2.3.3 Discharge Pipe

Discharge pipe shall be sized as shown. Discharge column retainers or spiders shall be utilized to maintain the discharge pipe centered in the well casing. A minimum of one retainer shall be provided for each 50 feet of discharge pipe. Provisions shall be made for fastening the retainer spiders to prevent them from sliding on the pipe and damaging the power cable when the pump is installed in the well.

### 2.3.4 Check Valves

A Check valve shall be provided in the column pipe at a pipe joint as recommended by the pump manufacturer. The check valve shall be vertical type, made of 300 Series stainless steel, of the same size as the pipe column in which it is installed. The check valve seat shall be Teflon with a 300 Series stainless steel insert. The check valve shall be designed to hold the column full of water.

## 2.4 PUMP ACCESSORIES

### 2.4.1 Water-Level Indicator Assembly

A water-level indicator assembly shall be provided for the pump installation. Indicator shall be air line-type.

#### 2.4.1.1 Air-line Indicator

Air-line type shall be manual and shall include a galvanized pipe or copper tube inserted between the well casing and the pump discharge column and shall extend a minimum of ten feet below the lowest pumping water level. Manual water-level indicator assembly shall include a pressure gauge, check

or bicycle valve, and air pump. The pressure gauge shall read in feet and shall have a range capable of permitting water-level measurement in the well under any conditions. A plastic or corrosion-resistant metal plate shall be affixed to the air line pressure gauge or pump house wall indicating the exact distance from the centerline of the pressure gauge to the end of the air line.

#### 2.4.2 Pressure Gauge

A pressure gauge of the direct-reading type, equipped with a shut-off cock and snubber, shall be provided on the discharge from the pump. Pressure gauge shall conform to ASME B40.1 and shall be calibrated in pounds per square inch in not more than 2 psi increment from zero to a minimum of 5 psi above the shut-off head of the pump. Rating point shall be at approximately the mid-point of the scale.

#### 2.4.3 Air-Vent Valve

Air-vent valve with the necessary pipe connections shall be provided to permit the automatic escape of air from the discharge column when the pump is started. Size of the air-vent valve and piping shall suit the actual requirements of the installation and the recommendations of the pump manufacturer.

### 2.5 ELECTRICAL EQUIPMENT

#### 2.5.1 General

Electrical motor-driven equipment specified shall be provided complete with motors, motor starters, and controls. Motor controls, equipment and wiring shall be specified in Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.5.2 Submersible Pumps

##### 2.5.2.1 Motor Design and Materials of Construction

The submersible pump motor shall be designed and manufactured expressly for the intended use. The motor shall be rated 208 volts, 3 phase, 60 Hz and such rating shall be stamped on the nameplate. The motor shall be a Franklin 4-inch squirrel-caged canned motor designed for submersible operation in conformance with NEMA standards, or equivalent. All materials in contact with the pumped fluids shall be 300 Series stainless steel or Teflon. The motor shall be water lubricated.

#### 2.5.3 Power Cables

Submersible pump power cables shall be specifically designed for use with submersible pumps, and shall be as recommended by the manufacturer of the motor with which the cables are used. Each cable shall not be less than No. 12AWG stranded copper and shall have the ampacity of not less than 125 percent of the motor full load current. Each conductor shall be insulated with a heat resistant, moisture resistant synthetic rubber or thermosetting plastic jacket. A separate stranded, green insulated, grounding conductor shall be provided for each circuit. Submersible cables shall be suitable for continuous immersion in water at the maximum depth encountered. Cables shall be securely supported from the pump column at intervals not to exceed 15 feet by corrosion resistant bands or clamps designed to prevent damage to the cable jacket. Except where cables connected to the motor terminal wiring, cables shall contain no splices in the length from the junction box or motor starter to the motor. Cables shall be terminated at the junction box or motor starter with a watertight cable connector. Splices in cables will be allowed only at the connection to the motor. Splices shall be factory fabricated and tested and shall be waterproof and suitable for continuous immersion at the maximum depth encountered. For each 50 feet of setting depth, 1 foot of extra cable length shall be provided to compensate

for possible twist or snag of the cables during installation. Where cables pass the pump bowl assembly, cables shall be flat or protected against damage by corrosion-resistant shield forming a smooth rounded surface. Sharp bends in the cables at the shield or at the connection to the motor will not be allowed.

## 2.6 EQUIPMENT APPURTENANCES

### 2.6.1 Attachments

All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A 123 or ASTM A 153 as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel shall be Type 316.

### 2.6.2 Special Tools

A complete set of all special tools, which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered those tools, which because of their limited use are not normally available, but which are necessary for the particular equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Contracting Officer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

The submersible pump shall be installed in accordance with SECTION 02523 (Submersible Pump Installation), following installation of the concrete vault. The arrangement of the pump unit and the suction and discharge piping is shown on the drawings. The arrangements shown are based upon the pumps of a particular manufacturer; however, any manufacturer's pumps that meet the requirements of these Specifications will be accepted. Additional costs due to revisions in piping or structures, required by any particular manufacturer's equipment, shall be borne by the Contractor.

### 3.2 PAINTING AND FINISHING

Unless otherwise specified all exposed ferrous metal not factory finished shall be painted as specified in Section 09900 PAINTING, GENERAL. No factory finished equipment or appurtenances shall be painted except that damaged factory finishes shall be retouched in an acceptable manner with paint obtained from the manufacturer. Nameplates shall not be covered with paint but shall be cleaned and legible at completion of work.

### 3.3 TESTING

Factory pump performance test shall be made in conformance with AWWA E101 for the following:

- a. Running test.
- b. Witnessed running test.
- c. Sample calculation from test readings.
- d. Shop inspection.
- e. Hydrostatic test of bowl assembly.

### 3.3.1 Field Equipment Test

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. The pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours. The pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer.

The Contractor shall provide an accurate and acceptable method of measuring the discharge flow. For submersible pumping units, an insulation resistance test of the cable and motor shall be conducted prior to installation of the pump, during the installation of the pump, and after the installation is complete. The resistance readings shall be not less than 10 megohms.

#### 3.3.1.1 Correct Installation of Appurtenances

Test shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manuals and automatic controls function properly.

#### 3.3.1.2 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected, within one (1) week and the tests shall be re-conducted. If the deficiency cannot be corrected within one (1) week, the pump shall be replaced, at no cost to the Contracting Officer.

### 3.4 FIELD TRAINING

Contractor shall conduct a training course for the maintenance and operating staff. The training period of 4 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. Contracting Officer shall be given at least two weeks advanced notice of such training.

### 3.5 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above the wiring and control diagrams. The framed instructions shall be posted before acceptance testing of the systems.

-- End of Section --

## SECTION 12320

## CABINETS AND COUNTERTOPS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA ANSI/BHMA A156.9 (1994) Cabinet Hardware

## KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA ANSI/KCMA A161.1 (1995) Recommended Performance & Construction Standards for Kitchen and Vanity Cabinets

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High-Pressure Decorative Laminates

## 1.2 DESIGN

Cabinets shall be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Cabinets shall be constructed as specified and shall meet the requirements of KCMA ANSI/KCMA A161.1. Wall and base cabinet assemblies shall consist of individual units joined into continuous sections. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation. Counters shall be provided with watertight sink rim when indicated. Drawers shall be removable and shall be equipped with position stops to avoid accidental complete withdrawals. Shelves shall be fixed or adjustable as indicated.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Cabinets and Countertops; GA.

Manufacturer's printed data, catalog cuts, installation and cleaning instructions.

## SD-04 Drawings

Cabinets and Countertops; GA.

Drawings showing each type of cabinet and related item, and clearly indicating the complete plan, location, and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and

attachments.

#### SD-09 Reports

Cabinets and Countertops; FIO.

Test reports certifying that all cabinets comply with the requirements of KCMA ANSI/KCMA A161.1. Tests shall be conducted by independent laboratories approved by KCMA. KCMA certification seals affixed to the cabinets will be accepted in lieu of certified test reports.

#### SD-14 Samples

Cabinets and Countertops; GA.

Samples shall be of sufficient size to show color, pattern, and method of assembly.

- a. Counter top and backsplash - One section, containing both.
- b. Door and drawer front - One of each, with hardware mounted.
- c. Melamine plastic color samples approximately 2 x 3 inches size.
- d. Paint/color samples approximately 2 x 3 inches size.

### 1.4 DELIVERY AND STORAGE

Cabinets shall be delivered to the jobsite wrapped in a protective covering. Cabinets shall be stored in accordance with manufacturer's recommendations in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Cabinets shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

## PART 2 PRODUCTS

### 2.1 CABINETS

Wall and base cabinets shall be of the same construction and same outside appearance. Door design shall be framed inset hardwood panels from vendors standard styles. Shelves shall be fixed or fully adjustable as indicated. Adjustable shelves shall be capable of adjusting on approximately 3 inch increments. Shelves shall be supported by self-locking clips or wood dowels. Dowels shall be approximately 5/16 inch in diameter by 1-9/16 inches long. Dowels shall be inserted into borings for the shelf adjustments. Shelves shall be minimum 1/2 inch thick plywood. Drawer fronts shall be 3/4 inch thick solid hardwood frame 7/16 inch solid wood panel.

#### 2.1.1 Frame Type Cabinets

The cabinets shall be constructed with frame fronts and solid ends, or frame construction throughout. Frame members shall be 3/4 inch thick by 1-1/2 inch wide; kiln-dried hardwood, glued together, and shall be either mortised and tenoned, dovetailed or doweled, nailed or screwed. Top and bottom corners shall be braced with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of wall cabinets shall be 1/8 inch thick plywood, or tempered hardboard. Backs of base and tall cabinets shall be 3/8 inch thick hardwood. Bottoms of cabinets shall be minimum 3/8 inch thick plywood or sound grade plywood and shall be braced with wood members glued in place. Cabinet ends shall be 5/8 inch thick hardwood plywood.

## 2.2 COUNTERTOPS AND BACKSPLASH

Countertop and backsplash shall be constructed of 3/4 inch thick plywood and shall be post formed cove type. Cove type shall be a single unit with self-edging and plastic laminate coved at the juncture of the countertop and backsplash. Backsplash shall be not less than 3-1/2 inches high. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 3/4 inch plywood shall be supplied.

## 2.3 Sink Rims

Sink rims shall be of the corrosion resistant steel clamping type, sized to the sink, and a standard product of a manufacturer regularly producing this type of equipment.

## 2.4 FINISH

### 2.4.1 Cabinet Finish

Cabinets shall be provided with a factory-applied durable finish in accordance with KCMA ANSI/KCMA A161.1 requirements and of a type standard with the manufacturer. Painted wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides shall be fabricated of wood which will be free of extreme color variations within each panel or between adjacent panels. Exposed exterior surfaces shall be paint-finished wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides fabricated of hardwood or grade C hardwood veneer.

### 2.4.2 NOT USED

### 2.4.3 Melamine Laminates on Countertops

Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are one unit, PF42 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3 and plastic laminate adhesive shall be contact type applied to both surfaces. For cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer.

### 2.4.4 Backer Sheets

Backer Sheets of high pressure plastic laminate, shall conform to NEMA LD 3, Grade BK20 and shall be applied to the underside of all core material.

## 2.5 HARDWARE

Hardware shall conform to BHMA ANSI/BHMA A156.9, shall be suitable for kitchen cabinet use, and shall include all miscellaneous hardware for a complete installation. Door hinges shall be self-closing type. Drawer runners shall have nylon rollers standard with the manufacturer. Hardware and fastenings for doors and drawers with plywood cores shall be of the through-bolt type.

## 2.6 COLOR, TEXTURE, AND PATTERN

Design, color, and finish shall be as indicated in the interior room finish key.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Cabinets shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with suitable devices to securely anchor each unit. Countertops, accessories, and hardware shall be installed as indicated. Installation shall be in accordance with the manufacturer's approved printed instructions. The inner edge of sink cut-outs in laminated plastic tops shall be painted with a coat of semigloss enamel paint and sink flanges shall be set in a bed of sealant. Closer and filler strips and finish moldings shall be provided as required. Prior to final acceptance, doors shall be aligned, and hardware shall be adjusted.

### 3.2 CLEANING

Cabinet and countertop surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

SECTION 13100  
LIGHTNING PROTECTION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

NFPA 780 (1997) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96 (1994; Rev thru Dec 1996) Lightning Protection Components

UL 96A (1994) Installation Requirements for Lightning Protection Systems

UL 467 (1993; Rev thru Aug 1996) Grounding and Bonding Equipment

UL Elec Const Dir (1997) Electrical Construction Materials Directory

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

## 1.2.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

## 1.3 SUBMITTALS

SD-04 Drawings

Lightning Protection System.

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

#### SD-13 Certificates

Materials and Equipment; GA.

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL Elec Const Dir will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. A letter of findings shall be submitted certifying UL inspection of lightning protection system

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

##### 2.1.2.1 Copper

Copper conductors used on nonmetallic stacks shall weigh not less than 375 pounds per thousand feet, and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 2/0 AWG.

#### 2.1.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. The tip of air terminals on buildings used for manufacturing, processing, handling, or storing explosives, ammunition, or explosive ingredients shall be a minimum of 2 feet above the ridge parapet, ventilator or perimeter. On open or hooded vents emitting explosive dusts or vapors under natural or forced draft, air terminals shall be a minimum of 5 feet above the opening. On open stacks emitting explosive dusts, gases, or vapor under forced draft, air terminals shall extend a minimum of 15 feet above vent opening. Air terminals more than 24 inches in length shall be supported by a suitable brace, with guides not less than one-half the height of the terminal.

#### 2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to ANSI C135.30. Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the job.

#### 2.1.5 Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation. Clamp-type connectors shall only be used for the connection of the roof conductor to the air terminal and to the guttering. All other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be listed for the purpose. The high compression fittings shall be the type which require a hydraulically operated mechanism to apply a minimum of 10,000 psi.

#### 2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

### PART 3 EXECUTION

#### 3.1 INTEGRAL SYSTEM

##### 3.1.1 General Requirements

The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

##### 3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 2 feet from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 2 feet in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 25 feet.

In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 2 inches for each foot of increase over 25 feet. On large, flat or gently sloping roofs, as defined in NFPA 780, air terminals shall be placed at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, smokestacks, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, air terminals shall be mounted

thereon, where practicable. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom. Where metal ventilators are installed with air terminals mounted thereon, the air terminal shall not be more than 24 inches away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement. Where metal ventilators are installed with air terminals mounted adjacent, the air terminal shall not be more than 24 inches away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement.

#### 3.1.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 8 inches. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

#### 3.1.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, there shall be at least one additional down conductor for each additional 50 feet of length or fraction thereof. On rectangular structures having French, flat, or sawtooth roofs exceeding 250 feet in perimeter, there shall be at least one additional down conductor for each 100 feet of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each wing.

On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 100 feet. On structures exceeding 50 feet in height, there shall be at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application shall not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 16 feet in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected by placing in pvc conduit for a minimum distance of 6' above finished grade level.

#### 3.1.1.4 NOT USED

#### 3.1.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down

conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

#### 3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, nor more than 8 feet, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 10 ohms if a counterpoise is not used. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 24 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 10 ohms, the Contracting Officer shall be notified immediately. A counterpoise, where required, shall be of No. 2/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors or their equivalent in the form of metal strips or wires are then buried in the trenches.

#### 3.1.2 Metal Roofs

Wood-Frame, Wall-Bearing Masonry or Tile Structure with Metallic Roof and Nonmetallic Exterior Walls, or Reinforced Concrete Building with Metallic Roof: Metal roofs which are in the form of sections insulated from each other shall be made electrically continuous by bonding. Air terminals shall be connected to, and made electrically continuous with, the metal roof as well as the roof conductors and down conductors. Ridge cables and roof conductors shall be bonded to the roof at the upper and lower edges of the roof and at intervals not to exceed 100 feet. The down conductors shall be bonded to roof conductors and to the lower edge of the metal roof.

Where the metal of the roof is in small sections, the air terminals and down conductors shall have connections made to at least four of the sections. All connections shall have electrical continuity and have a surface contact of at least 3 square inches.

#### 3.1.3 Metal Roofs With Metal Walls

Wood-Frame Building With Metal Roof and Metal Exterior Walls: The metal roof and the metal walls shall be bonded and made electrically continuous and considered as one unit. The air terminals shall be connected to and made electrically continuous with the metal roof as well as the roof and down conductors. All connections shall have electrical continuity and have a surface contact of at least 3 square inches.

#### 3.1.4 Steel Frame Building

The steel framework shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding steel frame, unless a specific method is noted on the drawings. The air terminals shall be connected to the structural steel framework at the ridge. Short runs of

conductors shall be used as necessary to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where a grounded metal pipe water system enters the building, the structural steel framework and the water system shall be connected at the point of entrance by a ground connector. Connections to pipes shall be by means of ground clamps with lugs. Connections to structural framework shall be by means of nut and bolt or welding. All connections between columns and ground connections shall be made at the bottom of the steel columns. Ground connections to grounding electrodes or counterpoise shall be run from not less than one-half of all the columns distributed equally around the perimeter of the structure at intervals averaging not more than 60 feet.

### 3.1.5 NOT USED

### 3.1.6 Igloo-Type Magazines

In earth-covered reinforced-concrete, igloo-type magazines, the reinforcing steel shall be made electrically continuous. Electrical continuity may be provided by clipping or brazing, unless a specific method is noted on the drawings. The air terminals and roof conductors shall be securely connected to, and made electrically continuous with, the reinforcing steel.

One air terminal shall be located on the top of the front wall and one on or adjacent to the ventilator in the rear. The air terminals shall extend vertically at least 2 feet above the top of the front wall and the highest point on the ventilator. Down conductors and grounding electrodes shall be provided at diagonally opposite corners of the magazine and shall be connected together. Grounding electrodes shall be connected to the horizontal reinforcing rods below the floor line of the wall system. The steel door frame shall be made electrically continuous with the reinforcing steel. The steel door shall be connected to the steel frame by means of a flexible copper strap or cable unless the steel hinges make the door and frame electrically continuous.

### 3.1.7 Tanks and Towers

#### 3.1.7.1 NOT USED

#### 3.1.7.2 Metal or Reinforced-Concrete Tanks and Towers

The metal or reinforcing steel shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding metal and tying or clipping reinforcing bars, unless a specific method is noted on the drawings. Air terminals and down conductors are required except on bolted, riveted, or welded 3/16-inch minimum, steel plate tanks. Ground connections and grounding electrodes are not required on metal tanks that are electrically continuous with a metallic underground pipe system. On other structures, two ground connections shall be provided approximately 180 degrees apart, at the base of the structure. Where buried metal pipes enter the tank or tower, one ground connection shall be connected to them, approximately 1 foot below finished grade. Metal guy wires on tanks and towers shall be grounded. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as grounded. Metal guy wires or cables set in concrete or attached to buildings or nonconducting supports shall be grounded to a ground rod driven full length into the ground.

### 3.2 NOT USED

### 3.3 NOT USED

### 3.4 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of

protection of an air terminal. Metal bodies of conductance having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected thereto shall be independently grounded.

### 3.5 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 1000 to 1500 feet of length when fences are located in isolated places, and every 500 to 750 feet when in proximity ( 100 feet or less) to public roads, highways, and buildings. Where the fence consists of wooden posts and horizontal metal strands only, down conductors consisting of No. 8 copper wire or equivalent shall be run from the ground rod the full height of the fence and fastened to each wire, so as to be electrically continuous. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 150 feet on each side of line crossings.

### 3.6 NOT USED

### 3.7 NOT USED

### 3.8 NOT USED

### 3.9 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

SECTION 13120  
STANDARD METAL BUILDING SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC-04	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design
AISC Pub No. S342 L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01	(1996) Cold-Formed Steel Design Manual
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 252	(1996) Welded and Seamless Steel Pipe Piles
ASTM A 463/A 463M	(1996a) Steel Sheet, Aluminum-Coated by the Hot-Dip Process
ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1996) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M	(1997a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1997) Steel, Sheet and Strip,

High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance

ASTM A 607 (1996) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled

ASTM A 618 (1996) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing

ASTM A 653/A 653M (1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 792/A 792M (1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B 241/B 241M (1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

ASTM B 308/B 308M (1996) Aluminum-Alloy 6061-T6 Standard Structural Profiles

ASTM B 429 (1995) Aluminum-Alloy Extruded Structural Pipe and Tube

ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 991 (1992) Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings

ASTM D 522 (1993a) Mandrel Bend Test of Attached Organic Coatings

ASTM D 523 (1989; R 1994) Specular Gloss

ASTM D 714 (1987; R 1994) Evaluating Degree of Blistering of Paints

ASTM D 968 (1993) Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D 1308 (1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes

ASTM D 1654 (1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 2244 (1993) Calculation of Color Differences from Instrumentally Measured Color

## Coordinates

ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995a) Measuring Adhesion by Tape Test
ASTM D 4214	(1997) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	s(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light - and Water-Exposure Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)	
ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)	
MBMA-01	(1996) Low Rise Building Systems Manual
SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)	
SMACNA-02	(1993; Errata) Architectural Sheet Metal Manual

## 1.2 GENERAL REQUIREMENTS

The metal building system covered under this specification shall be provided by a single manufacturer and shall include all components and assemblies that form a building. Structural standing seam metal roofing in this specification applies to the inspection and residue/turn-in buildings only. Structural Standing Seam Metal Roofing System, when specified, shall be furnished as part of a single manufacturer's system.

## 1.2.1 Building Configuration

Buildings shall have structural steel main building frames, and secondary framing including purlins and girts, engineered and fabricated by the building systems supplier. Buildings shall have vertical steel walls and gable roof system including soffits, gutters and downspouts. Roof slope shall be as shown on the drawings. Buildings shall be single-span structures with one of the following framing systems: continuous beam frames, column with rigid frame or rigid frame. Exterior doors and louvers shall be included in the metal building system. Building dimensions shall be not less than those indicated. The minimum inside clear dimensions shall be as shown on the drawings.

## 1.2.2 Qualifications

### 1.2.2.1 Manufacturer

Metal building shall be the product of a recognized steel building systems manufacturer who has been in the practice of manufacturing steel building systems for a period of not less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating steel building systems. The manufacturer shall be certified under the Metal Building Systems (MB) Certification Program, AISC FCD. Structural framing and covering shall be designed by a licensed Professional Engineer experienced in design of this work.

### 1.2.2.2 Installer

Erector shall have specialized experience in the erection of steel building systems for a period of at least 3 years. Framing shall be erected in accordance with MBMA-01, common industry practices and erection instructions describing the basic sequence of assembly, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads acting on the exposed framing, such as wind loads and seismic forces, as well as loads due to erection equipment and erection operation. Bracing furnished by the manufacturer for the metal building system shall not be assumed to be adequate during erection. Structural members shall not be field cut or altered without approval of the metal building manufacturer. Welds, abrasions, and surfaces not shop primed shall be primed after erection.

### 1.2.2.3 Manufacturer's Representative

A representative designated by the building manufacturer, who is familiar with the design of the building supplied and experienced in the erection of metal buildings similar in size to the one required under this contract, shall be present at the job site during construction, from the start of the structural framing erection until completion of the installation of the exterior covering, to assure that the building is erected properly.

## 1.3 DESIGN REQUIREMENTS

Criteria, loading combinations, and definitions shall be in accordance with MBMA-01.

### 1.3.1 Dead Loads

The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.

### 1.3.2 Collateral Loads

Collateral load of 5 pounds per square foot shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be shown on the shop (detail) drawings and the structure (frame, purlins, girts) shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds before design of the building commences.

### 1.3.3 Roof Live Loads

#### 1.3.3.1 Uniform Loads

Uniform roof live loads, including maintenance traffic and construction loads, shall be determined and applied in accordance with MBMA-01.

#### 1.3.3.2 Concentrated Loads

In addition to MBMA-01 roof live loads, a minimum design concentrated load of 300 pounds shall be used to simulate a construction load on roof panels. The concentrated load shall be applied at the panel midspan and shall be resisted by a single standing seam metal roof panel, or a 24 inches wide corrugated metal panel, assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

#### 1.3.4 Roof Snow Loads

The design roof snow loads, including effects of drifting, shall be determined and applied in accordance with MBMA-01 unless otherwise shown on the contract drawings.

#### 1.3.5 Wind Loads

Wind pressures shall be computed and applied in accordance with MBMA-01 unless otherwise shown on the contract drawings.

#### 1.3.6 Seismic Loads

Seismic loads shall be computed for seismic zone 1 in accordance with ASCE 7 using an importance factor of 1.

#### 1.3.7 NOT USED

#### 1.3.8 Foundations

Foundations shall be designed for an allowable soil bearing pressure of 4000 psf, a minimum bottom of footing depth of 3.5 feet below finish floor elevation, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

#### 1.3.9 Framing and Structural Members

Structural steel members and their connections shall be designed in accordance with AISC-04 or AISC Pub No. S342 L. Structural cold-formed steel framing members and their connections shall be designed in accordance with AISI-01. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180th of the span length. Members with openings in their webs shall be designed with consideration of the additional stresses which will result due to the openings. Deflections of the steel framing above and along the side of commercially framed door openings shall be limited to a maximum allowable deflection of 1/360 of the opening width to ensure proper operation of the doors. The contractor shall include the loads that the door transfers to the building frame in the design. Framed openings shall be designed to structurally replace the covering and framing displaced.

#### 1.3.10 Roofing and Siding

Except as otherwise specified, steel roofing and siding shall be designed in accordance with AISI-01. Maximum deflection for wall and roof panels under applied live load, snow or wind loads shall not exceed 1/180th of the span length. The design analysis shall establish that the roof, when deflected under loading combinations, shall not result in ponding. Maximum deflections shall be based on sheets continuous across two or more supports

with sheets unfastened and fully free to deflect. The calculated deflection from the concentrated load shall not exceed 1/180 of the span length. The methods for resisting lateral loads shall be cross-bracing, rigid frames, or wind columns.

#### 1.3.11 Provisions for Gutters And Downspouts

Gutters and downspouts shall be designed according to the requirements of SMACNA-02 for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads.

#### 1.3.12 Provisions for Louvers

Louvers shall be fixed-blade type designed for a minimum net open area as indicated, to be rainproof, and to resist vibration.

#### 1.3.13 Ventilators

#### 1.3.14 Drift Provisions

Lateral deflections, or drift, at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force resisting elements, shall conform to MBMA-01, but in no case should exceed height/180..

#### 1.3.15 NOT USED

#### 1.3.16 Grounding and Lightning Protection

Grounding and lightning protection shall be provided as specified in Section 13100 LIGHTNING PROTECTION SYSTEM.

### 1.4 DESIGN ANALYSIS

The design analysis shall be the design of a licensed Professional Engineer experienced in design of this work and shall include complete calculations for the building, its components, and the foundations. Foundations shown on the drawings are based on loads derived from a representative set of similar building types. The Contractor shall obtain the services of a licensed Professional Engineer to verify that the foundations shown are adequate for the building supplied using the criteria in paragraph Foundations. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. Wind forces on various parts of the structure, both positive and negative pressure, shall be calculated with the controlling pressure summarized. Lateral forces due to seismic loading shall be calculated and tabulated for the various parts and portions of the building. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included. Computer program output shall be annotated and supplemented with sketches to verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer, who shall function as a point of contact to answer questions during the detail drawing review.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Design Analysis; GA.

Design analysis (building and foundations including anchor bolt plans) as one package with the drawings.

Instruction Manuals; GA.

Manufacturer's literature for individual building component systems.

Erection Procedures; GA.

Manufacturer's erection instruction and erection drawings describing the preparation requirements, assembly sequence, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components.

## SD-04 Drawings

Metal Building Systems; GA.

Detail drawings consisting of catalog cuts, design and erection drawings, and an isometric view of the roof showing the design wind uplift pressure and dimensions of edge and corner zones. Shop painting and finishing specifications. Anchor bolt placement plan and column reactions.

## SD-08 Statements

Qualifications; FIO.

Qualifications of the manufacturer, the manufacturer's Representative when one is used, and qualifications and experience of the building erector. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall also include information regarding date of completion, name and address of owner, and how the structure is used.

## SD-13 Certificates

Metal Building Systems; GA.

a. A Certificate from the metal building manufacturer stating that the metal building was designed from a complete set of the contract drawings and specifications and that the building furnished complies with the specified requirements.

b. Mill certification for structural bolts, framing steel, roofing and siding, and steel wall liner panels.

c. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Metal Building System, a sample copy of which is attached to this section, the 20-year Manufacturer's Material Warranties, and the Manufacturer's 20-year System Weathertightness Warranty when one is required.

## SD-14 Samples

Accessories; GA.

One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roofing and Siding; GA.

One piece of each type and finish (exterior and interior) to be used, 9 inches long, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

Fasteners; GA.

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation; GA.

One piece of each type to be used, and descriptive data covering installation.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample, approximately 1 pound, and descriptive data.

Wall Liners; GA.

One piece, 9 inches long, full width.

#### 1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weathertight coverings and kept dry. Storage accommodations for roofing and siding shall provide good air circulation and protection from surface staining.

#### 1.7 WARRANTIES

The Metal Building System, composed of framing and structural members, roofing and siding, gutters and downspouts, accessories, fasteners, trim, and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

##### 1.7.1 Prime Contractor's Weathertightness Warranty

The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include but is not limited to the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim, flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and

fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached **WARRANTY FOR METAL BUILDING SYSTEMS**, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

#### 1.7.2 Manufacturer's Material and/or System Weathertightness Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Contracting Officer which cover all Metal Building System components:

a. A manufacturer's 20 year material warranty warranting that the specified zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system including fasteners and coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change colors in excess of five CIE or Hunter Lab color difference ( $\Delta E$ ) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to replacing the defective coated material.

#### 1.8 COORDINATION MEETING

A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal building system contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing/metal building system manufacturer, the roofing/metal building supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting

### PART 2 PRODUCTS

#### 2.1 BUILDING COMPONENTS

Each piece or part of the assembly shall be clearly and legibly marked to correspond with the drawings.

#### 2.2 FRAMING AND STRUCTURAL MEMBERS

Steel 1/8 inch or more in thickness shall conform to ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A 570/A 570M, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 653/A 653M, G 90 coating designation, 0.045 inch minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A 792/A 792M, coating designation, 0.045 inch minimum thickness. Aluminum sheet shall conform to ASTM B 209, 0.032 inch minimum thickness. Aluminum structural shapes and tubes shall conform to ASTM B 221, or ASTM B 308/B 308M. Structural pipe shall conform to ASTM A 53, ASTM A 252, ASTM A 500, ASTM A 501, ASTM A 618, ASTM B 221, ASTM B 241/B 241M or ASTM B 429. Holes for structural connections shall be made in the shop.

## 2.3 ROOFING AND SIDING

Roofing and siding shall be steel and shall have a factory color finish.

### 2.3.1 Roofing

Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope unless otherwise approved. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place. Provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. Panel shall have configurations for overlapping sheets. Exposed, penetrating fastener may be used. Height of corrugation at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

#### 2.3.1.1 Snow Guards

Snow guards to be a low profile, traditional style and engineered for permanent installation by means of soldering or adhesive sealant to metal roof surface. Color to match roof. Refer to plans for location.

### 2.3.2 Siding

Length of sheet shall be sufficient to cover the entire height of any unbroken height of wall surface unless otherwise approved. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place. Provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. Siding shall have configurations for overlapping adjacent sheets or interlocking ribs for securing adjacent sheets. Siding shall be fastened to framework using exposed or concealed fasteners.

### 2.3.3 Steel Panels

Roofing and Siding shall be zinc-coated steel conforming to ASTM A 653/A 653M, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 E5. Panels shall be 0.024 inch thick minimum, except that when the mid field of the roof is subject to design wind uplift pressures of 60 psf or greater or the steel covering is used as a diaphragm, the entire roof system shall have a minimum thickness of 0.030 inch. Prior to shipment, mill finish panels shall be treated to inhibit the formation of oxide corrosion. Panels that have become wet during shipment but have not started to oxidize shall be dried, and retreated in accordance with manufacturer's standard practice.

#### 2.3.4 NOT USED

#### 2.3.5 NOT USED

#### 2.3.6 Factory Color Finish

Panels shall have a factory applied silicone modified polyester finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 2 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 1.0 mil thickness.

The interior color finish shall consist of the same coating and dry film thickness as the exterior. The exterior color finish shall meet the test requirements specified below.

#### 2.3.6.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blistering, as determined by ASTM D 714; and a rating of 8, 1/32 inch failure at scribe, as determined by ASTM D 1654.

#### 2.3.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

#### 2.3.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B for 1000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference ( $\Delta E$ ) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

#### 2.3.6.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.3.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

#### 2.3.6.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel base metal.

#### 2.3.6.7 Specular Gloss

Finished roof surfaces for Inspection and Residue-Turn in Buildings shall have a specular gloss value of 30 plus or minus 5 at 60 degrees when

measured in accordance with ASTM D 523.

#### 2.3.6.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

#### 2.3.7 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the roofing or siding and shall not absorb or retain water.

#### 2.4 WALL LINERS

Wall liners shall be 0.018 inch thick minimum for steel with the same composition specified for siding, and formed or patterned to prevent waviness and distortion, and shall extend from floor to the ceiling. Matching metal trim shall be provided at base of wall liner, at top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have manufacturer's standard finishes. Colors shall be selected from manufacturer's standard finishes.

#### 2.5 FASTENERS

Provide fasteners for steel wall and roof panels of zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum wall and roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be the manufacturer's standard for the system provided.

##### 2.5.1 Screws

Screws shall be as recommended by the manufacturer to meet the design strength requirements.

##### 2.5.2 End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

##### 2.5.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.

#### 2.5.4 Blind Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

#### 2.5.5 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

#### 2.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be fabricated of zinc-coated steel or aluminum-zinc alloy coated steel and shall have manufacturer's factory color finish. Minimum uncoated thickness of materials shall be 0.018 inch for steel. All accessories necessary for the complete installation of the gutters and downspouts shall be furnished. Accessories shall include gutter straps, downspout elbows, downspout straps and fasteners fabricated from metal compatible with the gutters and downspouts.

#### 2.7 LOUVERS

Louvers shall be fabricated of aluminum, zinc-coated steel, or aluminum-zinc alloy coated steel; shall have manufacturer's factory color finish; and shall be furnished with bird and insect screens. Minimum uncoated thickness of materials shall be 0.048 inch for steel. Manually operated louvers shall be designed to be opened and closed from the operating floor.

#### 2.8 NOT USED

#### 2.9 NOT USED

#### 2.10 NOT USED

#### 2.11 NOT USED

#### 2.12 DOORS

##### 2.12.1 Hinged Doors

Hinged doors and frames shall receive a galvanic coating and factory primer and shall conform to the requirements of Section 08110 STEEL DOORS AND FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as specified in Section 08700 BUILDERS' HARDWARE.

#### 2.13 NOT USED

#### 2.14 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. Roof and wall insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

## 2.14.1 NOT USED

### 2.14.1.1 Blanket Insulation

Blanket insulation shall conform to ASTM C 991.

### 2.14.1.2 Insulation Retainers

Retainers shall be type, size and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

## 2.15 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber like consistency.

## 2.16 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

## 2.17 VAPOR RETARDER

### 2.17.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 0.1 perm or less when tested in accordance with ASTM E 96. Facing shall be white sheet vinyl. Facings and finishes shall be factory applied.

### 2.17.2 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to the requirements of ASTM D 4397. A single ply of 10 mil polyethylene sheet; or, at the option of the Contractor, a double ply of 6 mil polyethylene sheet shall be used. A fully compatible polyethylene tape shall be provided which has equal or better water vapor control characteristics than the vapor retarder material. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

## PART 3 EXECUTION

Not used.

## SECTION 13206

## STEEL STANDPIPES AND GROUND STORAGE RESERVOIRS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA ANSI/AWWA C115/A21.15 (1994) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

AWWA ANSI/AWWA C151/A21.51 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C652 (1992) Disinfection of Water-Storage Facilities

AWWA D100 (1996) Welded Steel Tanks for Water Storage

AWWA D103 (1987) Factory-Coated Bolted Steel Tanks for Water Storage

## MILITARY SPECIFICATIONS (MS)

MS DOD-C-24654 (Basic) Coatings, Epoxy, Potable Water Tanks (Metric)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 22 (1996) Standard for Water Tanks for Private Fire Protection

## NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 61 (1997a) Drinking Water System Components - Health Effects (Sections 1-9)

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Design and Construction Standards

The design, fabrication, and erection of the reservoir shall be in accordance with the applicable requirements of AWWA D100 or AWWA D103 except as modified herein. Earthquake design shall be for seismic zone 1. No additional thickness for corrosion allowance will be required. The reservoir shall be designed for a peak wind speed of 100 mph and snow load of 25 psf.

### 1.2.2 Welding for Tanks

Qualification of Welding Procedures, Welders, and Welding Operators for Welded Tanks, Section 8.2 of AWWA D100.

### 1.2.3 Design Requirements

The reservoir shall have a storage capacity of 100,000 gallons. The high-water level of reservoir shall be at approximate elevation 129.0 with the top of foundation approximately at elevation 99.4. The range between high and low water levels will be approximately 30 feet. Existing grade at proposed location is approximately elevation 98.5. The reservoir shall have such standard shell height and such diameter as will meet the requirements for the selected standard capacity and for the high-water level specified above. The reservoir may have supported cone roof, or supported toriconical roof, as approved. The reservoir shall be of welded or bolted construction.

### 1.2.4 Sizing of Standpipe and Reservoir

Section 6 of AWWA D100 or Section 4 of AWWA D103.

### 1.2.5 Coatings Certification

Coating materials for interior applications and all other materials which will be in normal contact with potable water shall conform to NSF ANSI/NSF 61. Certification by an independent third-party organization that all interior coatings and materials that come in contact with potable water comply with NSF ANSI/NSF 61 shall be provided.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

General Requirements; GA. Foundations; GA.

Design analyses and calculations.

#### SD-04 Drawings

Steel Standpipes and Ground Storage Reservoirs; GA.

Detail and erection drawings, before proceeding with any fabrication. The drawings shall be complete with details of all steel, pipe, and concrete work and with details of the assembling of all items required for the complete installation. Standard welding symbols as recommended by the American Welding Society shall be used. Details of all joints referenced on the drawings shall also be included.

#### SD-09 Reports

Tank Installation; FIO. Testing of Valves and Piping; FIO.

Copies of the following test results:

- a. Manufacturer's mill test reports for plate material.
- b. Mill and shop inspections by a commercial inspection agency.
- c. After acceptance of the structure, the radiographic film and/or test segments.
- d. At the conclusion of the work, a written report prepared by the Contractor certifying that the work was inspected in accordance with Section 11 of AWWA D100 or Section 9 of AWWA D103. The report shall also cover the hydrostatic and vacuum box leak tests and shall meet the requirements of Section 11.2.1 of AWWA D100 for welded tanks.

SD-13 Certificates

General Requirements; GA. Foundations; GA.

Certification by an independent third-party organization that all interior coating and materials that come in contact with the potable water comply with NSF ANSI/NSF 61.

A certificate signed by a registered professional engineer, providing the following information:

- a. Description of the structural design loading conditions used for the design of entire tank including the foundation.
- b. Description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in the design.
- c. A statement verifying that the structural design has been checked by experienced engineers specializing in hydraulic structures.
- d. A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and fabricating process as prescribed by the applicable AWWA standards.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Materials shall conform to the following requirements:

#### 2.1.1 Steel and Other Tank Materials

Section 2 of AWWA D100 or Section 2 of AWWA D103.

#### 2.1.2 Shop Fabrication

Section 9 of AWWA D100 or Section 7 of AWWA D103.

#### 2.1.3 Tank Insulation

24 inch wide by full shell height panels composed of 1 1/2" thick, foil faced (both sides) isocyanurate foam insulation laminated to .024" thick 3105H25 alloy aluminum sheathing. Sheathing shall be prefinished with a

baked polyester stucco embossed finish. R-value for thickness required shall be a minimum of 10.8 at 75 deg. mean temperature.

#### 2.1.4 Ductile-Iron Pipe

Pipe shall be ductile-iron pipe except for overflow piping. Pipes, fittings and specials shall conform to the requirements of ductile-iron pipe specified in Section 02660 WATER DISTRIBUTION SYSTEM and the paragraphs below:

##### 2.1.4.1 Pressure Ratings

Flanged pipes, fittings and specials shall conform to the applicable portions of AWWA ANSI/AWWA C110/A21.10, AWWA ANSI/AWWA C115/A21.15, and AWWA ANSI/AWWA C151/A21.51 for working pressure not less than 150 psi unless otherwise shown or specified.

##### 2.1.4.2 Joints

Grooved and shouldered joints shall not be used.

#### 2.1.5 Valves

Valves shall conform to the applicable requirements specified in Section 02510 WATER DISTRIBUTION SYSTEM. In addition, the supply to the reservoir shall be controlled by a 2 inch altitude valve, automatic in operation and accurately set to prevent overflow of the reservoir. The valve shall have flanged ends and a heavy cast iron body, shall be bronze fitted with renewable cups and seats, and shall be designed without metal-to-metal seats. The valve shall be cushioned when opening and closing to prevent water hammer or shock. Valves shall be provided with a travel indicator.

#### 2.1.6 Pressure Gauge

Pressure gauge of the direct-reading type, equipped with a shutoff cock, shall be provided, in the pumphouse, on the tank side and on the discharge side of the check or altitude valve. Gauges shall have 6 inch dials, shall be stem mounted, and shall conform to ASME B40.1. Accuracy of gauges shall be Grade A or better. Gauges shall be calibrated in pounds per square inch in not more than 2 pound increments form 0 to 50 pounds in excess of the normal operating pressure at the tank.

#### 2.1.7 Tank Heating Requirements

Refer to Specification Section 15836 WATER STORAGE TANK HEATERS.

### 2.2 ASSEMBLIES

#### 2.2.1 Tank Accessories

Section 7 of AWWA D100 or Section 5 of AWWA D103 and as hereinafter specified. Additional requirements for accessories are as follows:

##### 2.2.1.1 Manholes and Pipe Connections

Section 7 of AWWA D100 and Section 5 of AWWA D103 represent the minimum requirements. Number, type, location, and size of manholes and pipe connections will be as shown on the drawings. Inlet pipe shall be over-the-top type and shall be provided with deflectors. Outlet pipe connections to extend a minimum of 12 inches above tank bottom and shall be provided with vortex breakers as shown in NFPA 22.

##### 2.2.1.2 Overflow

The overflow for the tank shall consist of an overflow weir and outside

drop pipe, adequately supported and capable of discharging at a rate of 70 gpm without the water level exceeding the tangent line of the top of the shell. The weir shall be located as directed. The overflow pipe shall be steel, ASTM A 53 or equal, and shall terminate one to two feet above grade and shall be fitted with a flapper valve to prevent ingress of animals and insects.

#### 2.2.1.3 Vent

Vent shall be welded or bolted to the cover plate of the center manhole on the roof. Vent will be tank manufacturer's standard type mushroom vent with aluminum bird screen. The free area of the vent shall be sized 50 percent in excess of the 70 gpm pump-in rate and 1250 gpm pump-out rate. Screening for vent shall conform to Section 7.7.2 of AWWA D100 or Section 5.7.2 of AWWA D103 which ensures fail-safe operation in the event that screen frosts over and the bottom of the screen shall be sufficiently elevated for snow considerations in the area.

#### 2.2.1.4 Ladders and Safety Devices

Ladders and safety devices shall be provided in accordance with Sections 7.4 and 7.5 of AWWA D100 or Sections 5.4 and 5.5 of AWWA D103. Location of ladders shall be as shown on the drawings. Sections 7.4 and 7.5 of AWWA D100 and Sections 5.4 and 5.5 of AWWA D103 represent the minimum requirement. In addition, safety cage, rest platforms, roof ladder handrails, and other safety devices shall be provided as required by federal or local laws or regulations.

#### 2.2.1.5 Scaffold Cable Support

Provision shall be made for the attachment of a scaffold cable support at the top of the roof on welded tanks.

#### 2.2.2 Anchors

The following requirements shall be met:

- a. An adequate number of anchors designed to prevent overturning of the reservoir when empty shall be installed. If anchor bolts are used, the nominal diameter shall not be less than one inch, plus a corrosion allowance of at least 1/4 inch on the diameter. If anchor straps are used, they shall be pre-tensioned before welding to the tank shell.
- b. The anchor bolts shall be a right angle bend, hook, or plate washer, while anchor straps shall have only a plate welded to the bottom. The anchors shall be inserted into the foundation to resist the computed uplift.
- c. Attachment of anchors to the shell shall not add significant localized stresses to the shell. The method of attachment shall consider the effects of deflection and rotation of the tank shell. Anchors shall not be attached to the tank bottom. Attachment of the anchor bolts to the shell shall be through stiffened chair-type assemblies or anchor rings of adequate size and height.

### PART 3 EXECUTION

#### 3.1 FOUNDATIONS

Foundations for the reservoir shall be constructed on concrete, reinforced where necessary, and designed in accordance with Section 12 of AWWA D100 or Sections 11 and 8.5 of AWWA D103 for earth with a bearing value of 2500 psf, and shall be constructed in conformance with the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE, except as shown or

specified herein. An AWWA D100 Type 1 or an AWWA D103 Type 1 or Type 2 foundation shall be provided for the reservoir. Factor of safety on overturning of reservoir under design wind load shall be 1.33 minimum. When a footing is required, an inverted truncated pyramid of earth with 2 on 1 side slopes above top of footing may be used in determining overturning stability.

### 3.2 EXCAVATING, FILLING, AND GRADING

Excavating, filling, and grading shall conform to the applicable requirements of Section 02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

### 3.3 CATHODIC PROTECTION

Cathodic protection shall conform to Section 13100.

### 3.4 NOT USED

### 3.5 NOT USED

### 3.6 TANK INSTALLATION

Tank installation shall be in accordance with the following requirements:

#### 3.6.1 Welding

Section 8 of AWWA D100 or Section 6 of AWWA D103.

#### 3.6.2 Erection

Section 10 of AWWA D100 or Section 8 of AWWA D103.

#### 3.6.3 Inspections and Testing

Tank inspections and testing shall be in accordance with Section 11 of AWWA D100 or Section 9 of AWWA D103. Mill and shop inspections shall be performed by an approved commercial inspection agency. Radiographic inspections of the welded tank shell shall be performed by the Contractor. The Contractor shall perform the hydrostatic test and the vacuum box leak test of the tank bottom. Final leak test and hydrostatic test shall be performed before painting of welded tanks.

### 3.7 TANK INSULATION INSTALLATION

Secure internal attachment system of 1/4" diameter 7 x 19 galvanized wire ropes around tank shell, tension, and secure with high strength strand links. Locate cables on 3'-0" vertical centers.

Provide male and female standing seam flanges with factory roll-formed edges on both long sides of the panels. Join and seal panels mechanically in the field to form a double folded (1") high flexible, weathertight standing seam.

Secure vertical panels to the internal cables with stainless steel slips incorporated into the panel seam and tied to each crossing internal cable.

All manways, nozzle, brackets, vents and stairways shall have panels cut tight against them and shall be sealed with PSI 7000 polysulfide rubber sealant or equal.

### 3.8 PIPING INSTALLATION

Piping installation (except for overflow piping):

### 3.8.1 General Guidelines

Where details of fabrication or installation are not shown on the drawings, installation shall conform to AWWA C600.

### 3.8.2 Testing of Valves and Piping

After the reservoir has been erected and the valves and piping installed, and before field painting is begun, the valves and piping shall be hydrostatically tested in accordance with Section 4 of AWWA C600. The Contractor shall replace with sound material any defective material disclosed by the pressure test, and the test shall be repeated until the test results are satisfactory.

### 3.8.3 NOT USED

### 3.8.4 Plugging Ends

Pipe ends left for future connections shall be capped or plugged as directed.

## 3.9 PAINTING AND COATING OF TANK

Coating materials shall be delivered to the job site in their original containers bearing the manufacturer's name, product number, and volatile organic compound (VOC) content (grams per liter). Material Safety Data Sheets (MSDS) shall be provided for coatings.

### 3.9.1 Welded Tanks

#### 3.9.1.1 Exterior Surfaces

A prime coat a minimum of 2.0 mil thick followed by two coats of alkyd enamel, each a minimum of 1.5 mil thick. The prime coat shall be rust inhibitive red iron oxide, zinc oxide, oil and alkyd primer without lead or chromate pigments, in accordance with SSPC Paint 25. The finish coats shall be white alkyd enamel in accordance with Type I of SSPC Paint 104.

#### 3.9.1.2 Interior Surfaces

A prime coat at least 3.0 mil thick and a white final coat at least 5.0 mil thick. Each coat shall be a two-component catalyzed epoxy in accordance with MS DOD-C-24654. The primer shall contrast with the color of the finish coat.

### 3.9.2 Bolted Tanks

The tanks shall have a coating applied to both the interior and exterior surfaces in accordance with Section 10 of AWWA D103. Color shall be as approved.

## 3.10 DISINFECTION

The reservoir and connecting lines thereto shall be disinfected with chlorine before being placed in operation.

### 3.10.1 Tank

The reservoir shall be disinfected by the Contractor in accordance with AWWA C652. After the chlorination procedure is completed and before the storage facility is placed in service, the Contracting Officer will collect samples of water in properly sterilized containers for bacteriological testing from the full facility in accordance with paragraph 4.4.3 of AWWA C652. The tank will not be accepted until satisfactory bacteriological results have been obtained.

3.10.2 Piping

The valves and piping shall be disinfected by the Contractor in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

-- End of Section --

## SECTION 13850

## FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41 (1990) Audible Emergency Evacuation Signals

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 72 (1996) National Fire Alarm Code

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

## UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 38 (1994; Rev Jan 1994) ) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 268 (1996) Smoke Detectors for Fire Protective Signaling Systems

UL 268A (1993; Rev thru May 1997) Smoke Detectors for Duct Applications

UL 464 (1996) Audible Signal Appliances

UL 521 (1993; Rev Oct 1994) Heat Detectors for Fire Protective Signaling Systems

UL 797 (1993; Rev thru Mar 1997) Electrical Metallic Tubing

UL 864 (1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems

UL 1242 (1996) Intermediate Metal Conduit

UL 1971 (1995; Rev thru May 1997) Signaling Devices for the Hearing Impaired

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

### 1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

### 1.2.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

### 1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

### 1.2.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.2.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

### 1.2.7 Qualifications

#### 1.2.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

#### 1.2.7.2 Installer

The installing Contractor shall provide the following: Fire Alarm Technicians to perform the installation of the system. A Fire Alarm Technician with a minimum of 4 years of experience shall perform/supervise the installation of the fire alarm system. Fire Alarm technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

#### 1.2.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an

individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.
- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.
- d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers

### 1.3 SYSTEM DESIGN

#### 1.3.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, or NAC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

#### 1.3.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of alarm IDC and NAC. Smoke detectors shall not have combined alarm initiating and power circuits.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. A trouble buzzer and trouble light emitting diode (LED) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.
- h. Confirmation or verification modules for smoke detection initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices, other than smoke detectors, will be prohibited on circuits controlled by confirmation or verification modules.
- i. The fire alarm control panel shall provide supervised relays for HVAC shutdown. An override at the HVAC panel shall not be provided.
- j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- k. Zones for alarm IDC and NAC shall be arranged as indicated on the contract drawings.
- l. The fire alarm control panel shall be readily capable of future expansion and modification by qualified technicians. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

### 1.3.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of signals over the station radio fire reporting system. The signals shall be different for each zone.
- b. Visual indications of the alarmed zones on the fire alarm control panel annunciator.
- c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

### 1.3.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

#### 1.3.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

#### 1.3.6 NOT USED

#### 1.3.7 Interface With Other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

### 1.4 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

- (1) Identification of programmable portions of system equipment and capabilities.
- (2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- (3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.
- (4) Description of Fire Alarm Control Panel equipment operation.
- (5) Description of auxiliary and remote equipment operations.
- (6) Library of application software.
- (7) Operation and maintenance manuals described under SD-19 in the SUBMITTALS paragraph.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FI0" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Storage Batteries; GA.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; GA.

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts; GA.

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; GA.

Technical data which relates to computer software.

#### SD-04 Drawings

Fire Alarm Reporting System; GA.

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

#### SD-13 Certificates

Equipment; GA.

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

#### SD-19 Operation and Maintenance Manuals

Technical Data and Computer Software; GA.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The instructions shall include the information provided in paragraph TECHNICAL DATA AND COMPUTER SOFTWARE. The instructions shall include complete procedures for system revision and expansion, detailing

both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Instructions shall be approved prior to training.

#### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

### PART 2 PRODUCTS

#### 2.1 CONTROL PANEL

Control panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LEDs, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble LEDs shall be provided for each zone alarm. These LEDs shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

Visual annunciators shall be provided for each active zone and spare zone.

25% spare zones shall be provided. Each LED shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic, or metal sign with either raised or engraved letters. Zone identification shall consist of a word description of the zone. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

##### 2.1.1 Remote System Trouble Audible/Visual Appliance

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel's integral trouble signal. The audible device shall be silenced by the system trouble silence switch located at the remote location, but shall not extinguish the visual indicator. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Trouble" shall be provided at the audible appliance. The visual appliance located with the audible appliance shall not be extinguished until the trouble has been cleared.

##### 2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

##### 2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

## 2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

## 2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

## 2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on surface for finished areas and semi-flush for unfinished mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

## 2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Installed devices shall conform to the NFPA 70 hazard classification of the area where devices are to be installed.

### 2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as shown on drawings, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 70 by 70 ft.

#### 2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization type. Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED suitable for mounting in a finished, visible location.

##### 2.5.2.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector shall be capable of withstanding ambient air velocity up to 300 fpm in accordance with UL 268.

##### 2.5.2.2 NOT USED

##### 2.5.2.3 NOT USED

##### 2.5.2.4 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

## 2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

### 2.6.1 NOT USED

### 2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted projector, type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 87 dBA at 10 feet in general use areas and 93 dBA at 10 feet in hazardous rated areas. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

### 2.6.3 NOT USED

### 2.6.4 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 95 candela. Strobe shall be surface mounted in finished areas and semi-flush mounted in unfinished areas.

### 2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units, except that they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

### 2.7 NOT USED

## 2.8 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

### 2.8.1 NOT USED

### 2.8.2 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

### 2.8.3 Wiring

Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for Fire Alarm circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.

#### 2.8.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

##### 3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

##### 3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

##### 3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

##### 3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling,

raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

### 3.1.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

### 3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

### 3.1.7 Supervisory and Alarm Contacts

Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as identified in NFPA 72 and as indicated on the drawings. Contacts shall be provided in accordance with other sections of the specifications and specific instructions on corresponding drawings. Section 13930 WET PIPE SPRINKLER SYSTEM, 13945 PREACTION AND DELUGE SYSTEMS, FIRE PROTECTION.

## 3.2 OVERVOLTAGE AND SURGE PROTECTION

### 3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

### 3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

## 3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

## 3.4 NOT USED

## 3.5 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

### 3.5.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be

retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

### 3.5.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault.
- k. Short circuit faults.
- l. Stray voltage.
- m. Loop resistance.

### 3.6 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --

## SECTION 13920

## FIRE PUMPS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 193/A 193M	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 795	(1996) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 42	(1996) Seamless Copper Pipe, Standard Sizes
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 135	(1996) Seamless Brass Tube
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM F 436	(1993) Hardened Steel Washers

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1986; R 1994) Malleable Iron Threaded

## Pipe Unions Classes 150, 250, and 300

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C500	(1993; C500) Metal-Sealed Gates Valves for Water Supply Service

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1996; Errata; TIA 96-1) Installation of Centrifugal Fire Pumps
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 37	(1997) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1996; Errata 96-4) National Electrical Code
NFPA 1963	(1993) Fire Hose Connections

## UNDERWRITERS LABORATORIES (UL)

UL 80	(1996) Steel Inside Tanks for Oil-Burner Fuel
UL 142	(1993; Rev Apr 1995) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 262	(1994; Rev thru Apr 1997) Gate Valves for Fire-Protection Service
UL 448	(1994; Rev Jun 1995) Pumps For Fire-Protection Service
UL 1247	(1995; Rev thru May 1997) Diesel Engines

## For Driving Centrifugal Fire Pumps

UL Fire Prot Dir

(1997) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Product

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the jobsite.

## 1.2.2 Description

Fire pump, piping and associated equipment shall be provided complete and ready for operation. The fire pump shall be horizontal centrifugal fire pump. The fire pump shall be diesel engine driven fire pump. Fire pump, appurtenances and installation shall conform to NFPA 20, unless more stringent requirements are specified herein or are indicated on the drawings. In NFPA 20, the advisory provisions including those listed in the appendix shall be considered mandatory; reference to the authority having jurisdiction shall be interpreted to mean the Contracting Officer. Devices and equipment for fire protection service shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b.

## 1.2.3 Sequence of Operation

## 1.2.3.1 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 80 psi. Pump shall automatically stop when the system pressure reaches 90 psi and after the pump has operated for the minimum pump run time specified herein.

## 1.2.3.2 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 75 psi. The fire pump shall continue to run until manually shut down.

## 1.2.4 Safety Requirements

Coupling, rotating parts, gears, projecting equipment, etc. shall be fully enclosed or properly guarded so as to prevent possible injury to persons that come in close proximity of the equipment. The Contractor shall conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

## 1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work and verify all dimensions in the field. The Contractor shall notify the Contracting Officer of any discrepancy before performing the work.

## 1.2.6 Electrical Work

Electric motor and controls shall be in accordance with NFPA 20 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 16415 ELECTRICAL WORK, INTERIOR.

### 1.2.7 Factory Tests

Fire pump shall be tested by the manufacturer before shipment to provide detailed performance data and to demonstrate its compliance with the specifications.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Unless otherwise indicated, 6 copies of each item shall be submitted. Submittals, except Fire Protection Engineer's Qualifications shall be submitted concurrently as a complete package. Each submittal shall be certified in writing by the Fire Protection Engineer. The Fire Protection Engineer shall certify that the submittal is complete, that the equipment and equipment arrangement meets contract requirements, and that the proposed system is coordinated and compatible with all other equipment connected to the system, the physical space, and the power sources. The Fire Protection Engineer shall sign and date all shop drawing submittal sheets and revisions. The submittal will be reviewed by the U.S. Army Engineer District Fire Protection Engineer.

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

#### SD-01 Data

Equipment; GA.

Manufacturer's catalog data for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

- a. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.
- b. Pressure maintenance pump and controller.
- c. Piping and fittings.
- d. Valves, including gate, check, globe and relief valves.
- e. Gauges.
- f. Hose valve manifold test header and hose valves.
- g. Flow meter.
- h. Restrictive orifice union.
- i. Associated devices and equipment.

Final Test; GA.

A written request for scheduling of the final test at least 15 days prior to the date that the final acceptance test is to take place and after successful completion of the preliminary tests.

#### SD-04 Drawings

Pump Room, Equipment and Piping; GA.

Detailed drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

- a. Fire pumps, controllers, piping, valves, and associated equipment.
- b. Sensing line for each pump including the jockey pump.
- c. Engine fuel system for diesel driven pumps.
- d. Engine cooling system for diesel driven pumps.
- e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
- f. Restraint of underground water main at exit-point to the building.

A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

As-Built Drawings; FIO.

Detailed drawings updated to reflect as-built conditions after all associated work is completed, on reproducible full-size mylar film, no later than 10 working days after completion of the Final Tests. Each as-built drawing shall have a title block similar to the contract drawings.

SD-06 Instructions

Framed Instructions; FIO.

Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for safe operation, sequence of operation, and procedures for safely starting and stopping the system, prepared in typed form, framed under glass or in laminated plastic. Instructions shall be posted where directed by the Contracting Officer. Wiring and control diagrams showing the complete layout of the entire system shall be framed under glass or in approved laminated plastic and posted near each controller as directed by the Contracting Officer. Proposed instructions, diagrams and other sheets shall be submitted for approval prior to posting. Framed instructions shall be posted before acceptance testing of the system.

SD-09 Reports

Field Tests; GA.

Test reports in booklet form showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches.

The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

#### SD-13 Certificates

Engineer's Qualifications; FIO.

Prior to all other submittals, certification that the Fire Protection Engineer is a registered Fire Protection Engineer or a Registered Engineer who has had at least 4 years experience in fire protection and fire pump installation design.

Preliminary Test; GA.

A signed and dated certificate that preliminary tests have been conducted, and that the fire pump installation is complete and ready to be placed in operation, prior to submitting a formal request for a final inspection and test. The certificate shall include the names, companies, phone numbers, and titles of persons conducting and witnessing the test, including the required manufacturer's representatives. Complete test procedures, as well as results and readings taken during the preliminary tests shall be included.

Piping; FIO.

A signed statement from the piping manufacturer certifying that the piping meets requirements specified. The statement shall be signed and dated after the award of this contract, shall include the name of the project, and shall list the specific requirements which are being certified.

#### SD-18 Records

Test Procedures; GA.

Detailed test procedures for testing the fire pump system, 60 days prior to performing the pump tests.

#### SD-19 Operation and Maintenance Manuals

Fire Pumps; GA.

Operating instructions outlining step-by-step procedures required for fire pump startup, operation and shutdown shall be provided. The instructions shall include the manufacturer's name, model number, catalog cuts, diagrams, drawings, parts list, and descriptive data covering the proper operation and testing.

Six complete copies of maintenance instructions listing routine maintenance procedures and frequencies, possible breakdowns and repairs, troubleshooting guides, a complete list of parts and current sources, and recommended spare parts to be kept on hand. The instructions shall include simplified diagrams for the system as installed.

### 1.4 MANUFACTURER'S SERVICES

The Contractor shall obtain the services of the fire pump manufacturer, the fire pump controller manufacturer, and the diesel engine driver manufacturer or their representative. The persons providing this service shall be factory-trained, shall be experienced in the installation, adjustment, and operation of the equipment and shall supervise the installation, the adjustments, and the testing of equipment. The persons providing the manufacturer service shall be present during the preliminary and final tests and shall assist in the testing of the equipment.

## 1.5 DELIVERY AND STORAGE

Equipment delivered to the site or placed in storage shall be protected from weather, humidity and temperature variations, dirt, dust, and other contaminants.

## PART 2 PRODUCTS

### 2.1 FIRE PUMP

Fire pump shall be diesel engine driven. Each pump capacity shall be rated at 1250 gpm with a rated net pressure of 80 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal horizontal split case fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

### 2.2 NOT USED

### 2.3 DIESEL ENGINE DRIVER

Diesel engine driver shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Driver shall be of the make recommended by the pump manufacturer. The engine shall be closed circuit, liquid-cooled with raw water heat exchanger. Diesel engine shall be electric start type taking current from 2 battery units. Engine shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gauge, lubricating oil pressure gauge, water temperature gauge, and ammeter gauge. Engine shall be connected to horizontal-shaft pump by flexible couplings. For connections to vertical-shaft fire pumps, right-angle gear drives and universal joints shall be used.

#### 2.3.1 Engine Horsepower

Engine shall have adequate horsepower to drive the pump at all conditions of speed and load over the full range of the pump performance curve. The horsepower rating of the engine driver shall be as recommended by the pump manufacturer and shall be derated for temperature and elevation in accordance with NFPA 20. Ambient temperature at the pump location shall be 99 degrees F. Site elevation shall be 172 feet above mean sea level (MSL).

#### 2.3.2 Exhaust System External to Engine

Exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler shall be provided for each diesel engine driver to reduce noise levels less than 95 dBA. A flexible connector with flange connections shall be provided at the engine. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 1000 degrees F.

##### 2.3.2.1 Steel Pipe and Fittings

ASTM A 53, Schedule 40, black steel, welding end connections. ASME B16.9 or ASME B16.11 welding fittings shall be of the same material and weight as the piping.

##### 2.3.2.2 Flanges

ASME B16.5, Class 300. Flanges shall be provided at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 0.0625 inch thick. ASTM A 193/A 193M, Grade B8

bolts and ASTM A 194/A 194M, Grade 8 nuts shall be provided.

#### 2.3.2.3 Piping Insulation

Products containing asbestos will not be permitted. Exhaust piping system including the muffler shall be insulated with ASTM C 533 calcium silicate insulation, minimum of 3 inches thick. Insulation shall be secured with not less than 0.375 inch width Type 304 stainless steel bands spaced not more than 8 inches on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.016 inches, a factory-applied polyethylene and kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 0.5 inch wide stainless steel bands, spaced not less than 8 inches on centers. Longitudinal and circumferential seams of the jacket shall be lapped not less than 3 inches. Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

#### 2.4 NAMEPLATES AND MARKINGS

Pump and motor shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

#### 2.5 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F. The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

##### 2.5.1 NOT USED

##### 2.5.2 Controller for Diesel Engine Driven Fire Pump

Controller shall be equipped with two battery chargers; two ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller shall be equipped with the following supervisory alarm functions:

- a. Engine Trouble (individually monitored)
  - (1) Engine overspeed
  - (2) Low Oil Pressure
  - (3) High Water Temperature

- (4) Engine Failure to Start
- (5) Battery
- (6) Battery Charger/AC Power Failure
- b. Main Switch Mis-set
- c. Pump Running
- d. Pump Room Trouble (individually monitored)
  - (1) Low Fuel
  - (2) Low Pump Room Temperature
  - (3) Low Reservoir Level

Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, pump running, engine trouble and pump room trouble; and terminals for remote start. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset. When low water tank level signal is received, the controller shall cause the engine to shut down without time delay. Refer to Section 15950 for tank level sensing.

## 2.6 BATTERIES

Batteries for diesel engine driver shall be sealed lead acid or lead calcium batteries. Batteries shall be mounted in a steel rack with non-corrosive, non-conductive base, not less than 12 inches above the floor.

## 2.7 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inch H58 brass tubing complying with ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch orifice. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged per NFPA 20. One of the test connections shall be equipped with a 0 to 200 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

## 2.8 PRESSURE MAINTENANCE (JOCKEY) PUMP

Pressure maintenance pump shall be electric motor driven, horizontal shaft or in-line vertical shaft, centrifugal type with a rated discharge of 10 gpm at 90 psig. Pump shall draft as indicated and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type

shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

#### 2.8.1 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely terminally wired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

#### 2.9 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

Fuel system shall be provided that meets all requirements and advisory provisions of NFPA 20 and NFPA 37. The fuel tank vent piping shall be equipped with screened weatherproof vent cap. Vents shall be extended to the outside. Each tank shall be equipped with a fuel level gauge. Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be steel piping, except supply and return piping may be copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill cap shall be able to be locked by padlock. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. The bottom of the tank shall be pitched 1/4 inch per foot to the side opposite the suction inlet connection, and to an accessible 1 inch plugged globe drain valve.

##### 2.9.1 Steel pipe

ASTM A 53, hot-dipped zinc-coated, Schedule 40, threaded connections. Fittings shall be ASME B16.3, zinc-coated, threaded malleable iron fittings. Unions shall be ASME B16.39 zinc-coated, threaded unions.

##### 2.9.2 Copper Tubing

ASTM B 88, Type K, soft annealed, with ASME B16.26 flared fittings.

##### 2.9.3 Diesel Fuel Tanks

UL 80 or UL 142 for aboveground tanks.

##### 2.9.4 Valves

An indicating and lockable ball valve shall be provided in the supply line adjacent to the tank suction inlet connection. A check valve shall be provided in fuel return line. Valves shall be suitable for oil service. Valves shall have union end connections or threaded end connections.

- a. Globe valve: MSS SP-80 Class 125

- b. Check valve: MSS SP-80, Class 125, swing check
- c. Ball valve: Full port design, copper alloy body, 2-position lever handle.

## 2.10 PUMP BASE PLATE AND PAD

A common base plate shall be provided for each horizontal-shaft fire pump for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 1 inch galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 4 inch reinforced concrete pad that is an integral part of the reinforced concrete floor.

## 2.11 ABOVEGROUND WATER PIPING

### 2.11.1 Pipe Sizes 2.5 Inches and Larger

#### 2.11.1.1 Pipe

Piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inches and greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside per NFPA 20.

#### 2.11.1.2 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

#### 2.11.1.3 Gaskets

Gaskets shall be AWWA ANSI/AWWA C111/A21.11, cloth inserted red rubber gaskets.

#### 2.11.1.4 Bolts

Bolts shall be ASTM A 193/A 193M, Grade B8. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

#### 2.11.1.5 Nuts

Nuts shall be ASTM A 194/A 194M, Grade 8.

#### 2.11.1.6 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provide under all bolt heads and nuts.

### 2.11.2 Piping Sizes 2 Inches and Smaller

#### 2.11.2.1 Steel Pipe

Steel piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Fittings shall be ASME B16.39, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated

unions.

#### 2.11.2.2 Copper Tubing

Copper tubing shall be ASTM B 88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B 42 copper pipe with threaded end connections.

#### 2.11.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

#### 2.11.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire protection service. Valves shall have flange or threaded end connections.

##### 2.11.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

##### 2.11.4.2 Tamper Switch

The suction control valves, the discharge control valves, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

##### 2.11.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

##### 2.11.4.4 Relief Valve

Relief valve shall be pilot operated or spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

##### 2.11.4.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

#### 2.12 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b bronze hose gate valves with 2.5 inch American National Fire Hose Connection Screw Standard Threads (NH) per NFPA 1963. The number of valves shall be per NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 feet and no less than 2 feet above grade.

#### 2.13 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825bas flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. The flow meter shall be arranged in accordance with Figure A-2-14.2.1 of NFPA 20.

The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Automatic air release shall be provided if flow meter test discharge is piped to the pump suction and forms a closed-loop meter arrangement as defined in Figure A-2-14.2.1 of NFPA 20.

#### 2.14 PIPE SLEEVE

A pipe sleeve shall be provided at each location where piping passes through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Sleeves shall be grouted in position during construction. Sleeve shall be of sufficient length to pass through the entire thickness of the wall, ceilings, roofs and floors. Not less than 1 inch clearance shall be provided between pipe exterior surface and the interior of the sleeve, and between the tie rods and the interior of the sleeve. The space shall be firmly packed with mineral wool insulation and caulk at both ends with plastic waterproof cement which will dry to a firm but pliable mass, or with a segmented elastomeric seal. Where pipes pass through fire walls or fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07270 FIRESTOPPING. Sleeves in masonry and concrete walls, ceiling, roofs and floors shall be hot-dip galvanized steel, ductile-iron, or cast-iron. Other sleeves shall be galvanized steel sheet pipe not less than 0.90 psf.

#### 2.15 ESCUTCHEON (WALL) PLATES

Escutcheon plates shall be one-piece or split-hinge type metal plates and shall be provided for piping passing through floors, walls, and ceiling in exposed areas. In finished areas, plates shall be polished stainless steel or chromium-plated finish on copper alloy. In unfinished areas, plates shall have painted finish. Plates shall be secured in position.

#### 2.16 UNDERGROUND PIPING

##### 2.16.1 Pipe and Fittings

Underground piping and piping under the building slab shall be ductile-iron pipe and fittings. Piping shall be AWWA ANSI/AWWA C151/A21.51 ductile-iron pipe with AWWA ANSI/AWWA C110/A21.10 fittings and shall conform to NFPA 24. Piping beyond 5 feet of the building shall be provided under Section 02660 WATER DISTRIBUTION SYSTEM.

##### 2.16.2 Valves

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation.

##### 2.16.2.1 Valve Boxes

Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

##### 2.16.3 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and

lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavement.

## 2.17 CHLORINATING AGENTS

Chlorinating agent must comply with one of the following.

### 2.17.1 Liquid Chlorine

AWWA B301

### 2.17.2 Calcium Hypochlorite and Sodium Hypochlorite

AWWA B300

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

### 3.2 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

#### 3.2.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

#### 3.2.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D 3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

#### 3.2.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

##### 3.2.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 10 foot intervals.

##### 3.2.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	MAXIMUM SPACING (FEET)									
	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.2.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. Concrete thrust block shall be provided at elbow where pipe turns up towards floor, and the pipe riser shall be restrained with steel rods from the elbow to the flange above the floor. After installation per NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contracting Officer. Minimum depth of cover shall be 3 feet.

3.3 ELECTRICAL WORK

Except as modified herein, interior wiring methods shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR; exterior wiring methods shall be in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEMS, UNDERGROUND or Section 16370 ELECTRICAL DISTRIBUTION SYSTEMS, AERIAL as appropriate.

3.4 FIELD PAINTING AND FINISHING

Field painting and finishing shall conform to the requirements specified in Section 09900 PAINTING, GENERAL. Piping shall be provided with plastic labels of standard manufacture to identify piping as FIRE PUMP DISCHARGE, FIRE PUMP SUCTION, FIRE PUMP BYPASS, FIRE PUMP TEST HEADER, TO SYSTEM, and RELIEF VALVE DISCHARGE. Labels shall have red letters 1 inch high, 1/4 inch brush stroke, on white background.

3.5 INSTRUCTING OPERATING PERSONNEL

Upon completion of the work and at a time designated by the Contracting Officer, the Contractor shall provide, for a period of not less than one 8-hour working day, the services of experienced technicians regularly employed by the manufacturer of the fire pump, the fire pump controller, and the pump drivers to instruct Government operating personnel in the proper operation, inspection, testing, and maintenance of the equipment. Manufacturer's representatives who were present during the final tests shall be present and shall conduct or assist in the instruction.

3.6 FLUSHING

The fire pump suction and discharge piping shall be flushed at 120 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 120 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Flushing operations shall continue until water is clear, but not less than 10 minutes. The Contractor shall submit a signed and dated flushing certificate before requesting field testing.

3.7 FIELD TESTS

### 3.7.1 Hydrostatic Test

Piping shall be hydrostatically tested at 225 psig for a period of 2-hours, or at least 50 psi in excess of the maximum pressure, when the maximum pressure in the system is in excess of 175 psi.

### 3.7.2 Preliminary Test

The fire pump manufacturer, the fire pump controller manufacturer, and the diesel engine manufacturer (when supplied) or their representative shall witness the complete operational testing of the fire pump and drivers. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. All test results and readings shall be recorded during the tests and signed by the witnessing manufacturer's representative.

### 3.7.3 Final Test

The District Fire Protection Engineer and Fort Dix Fire Prevention Bureau will witness the final tests. The Contractor shall take all readings and measurements. An experienced technician regularly employed by the pump installer shall be present during the test. The pump manufacturer, the fire pump controller manufacturer, and the diesel engine manufacturer (when supplied), or their representative shall be present for the final tests. Where pumps are diesel driven, an experienced technician employed by the engine manufacturer capable of demonstrating engine trouble alarms and operating features shall be present. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test. The final acceptance test shall include the following:

#### 3.7.3.1 Inspection

Thorough inspection of the fire pump installation, including visual observation of the pump while running shall be conducted. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards.

#### 3.7.3.2 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

#### 3.7.3.3 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on

the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

#### 3.7.3.4 Battery Changeover

Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.

#### 3.7.3.5 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

#### 3.7.3.6 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

#### 3.7.4 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall performed corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

#### 3.7.5 Test Equipment

The Contractor shall provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. The Government will furnish water for the tests.

#### 3.7.6 Test Documentation

Contractor shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Contractor shall record all test results and plot curve of each pump performance during the test. The Contractor shall provide complete pump acceptance test data of each fire pump. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. The Contractor shall provide pump test data sheet in a properly labeled three ring binder.

-- End of Section --

## SECTION 13930

## WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 135	(1997) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 795	(1996) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88	(1996) Seamless Copper Water Tube

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B18.2.1	(1996) Square and Hex Bolts and Screws Inch Series
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch

## Series)

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA ANSI/AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1996; Errata 13-96-1) Installation of Sprinkler Systems
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 231C	(1995; TIA 95-1) Rack Storage of Materials
NFPA 1963	(1993) Fire Hose Connections

## NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
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## UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1998) Building Materials Directory
UL Fire Prot Dir	(1998) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation.

### 1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of .2 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

#### 1.2.1.1 Hose Demand

An allowance for exterior hose streams of 500 gpm shall be added to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building.

#### 1.2.1.2 Basis for Calculations

The design of the system shall be based upon a storage tank and fire pump water supply. The fire pump shall provide 1250 gpm at 80 psi. Water supply shall be presumed available at the Pump House Building. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing and 140 for new cement-lined ductile-iron piping.

### 1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed square feet limits specified in NFPA 13 for ordinary hazard occupancy.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package. The package will be reviewed by the U.S. Army Engineer District Fire Protection Engineer. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Load Calculations for Sizing Sway Bracing

Load calculations shall be provided for sizing of sway bracing.

Sprinkler System Equipment; GA.

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; GA.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts; FIO.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

#### SD-04 Drawings

Sprinkler System Shop Drawings; GA.

Detail drawings conforming to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

- a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.
- b. Floor plans drawn to a scale not less than  $1/8" = 1'-0"$  which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.
- c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.
- d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.
- e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Drawings; FIO.

As-built drawings, no later than 14 working days after completion of the Final Tests. The sprinkler system shop drawings shall be updated to reflect as-built conditions after work is completed and shall be on reproducible full-size mylar film.

#### SD-06 Instructions

Test Procedures; GA.

Proposed test procedures for piping hydrostatic test, testing of alarms, at least 14 days prior to the start of related testing.

## SD-07 Schedules

Preliminary Tests; GA.

A schedule of preliminary tests, at least 14 days prior to the proposed start of the tests.

Final Test; GA.

Upon successful completion of tests specified under paragraph PRELIMINARY TESTS, written notification shall be given to the Contracting Officer of the date for the final acceptance test. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

## SD-08 Statements

Installer Qualifications; GA.

Qualifications of the sprinkler installer.

Submittal Preparer's Qualifications; GA.

The name and documentation of certification of the individual who will prepare the submittals, prior to the submittal of the drawings and hydraulic calculations.

## SD-13 Certificates

Contractor's Material & Test Certificates; FIO.

Certificates, as specified in NFPA 13, shall be completed and signed by the Contractor's Representative performing required tests for both underground and aboveground piping.

## SD-19 Operation and Maintenance Manuals

Sprinkler System; GA.

Manuals shall be in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures possible breakdowns, and repairs, and troubleshooting guide. This shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

## 1.4 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software specifically designed for fire protection system design. Software which uses k-factors for typical branch lines is not acceptable. Calculations shall be taken back to the water supply source unless water supply data is otherwise indicated. Calculations shall substantiate that the design area indicated is the hydraulically most demanding. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent

pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

#### 1.5 SUBMITTAL PREPARER'S QUALIFICATIONS

The sprinkler system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014.

#### 1.6 INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

#### 1.7 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

#### 1.8 DELIVERY AND STORAGE

Equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

### PART 2 PRODUCTS

#### 2.1 GENERAL EQUIPMENT REQUIREMENTS

##### 2.1.1 Standard Products

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

##### 2.1.2 Requirements for Fire Protection Service

Equipment and materials shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory

Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

### 2.1.3 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

## 2.2 UNDERGROUND PIPING SYSTEMS

### 2.2.1 Pipe

Piping from a point 6 inches above the floor to a point 5 feet outside the building wall shall be ductile iron with a rated working pressure of 150 psi conforming to AWWA ANSI/AWWA C151/A21.51, with cement mortar lining conforming to AWWA ANSI/AWWA C104/A21.4. Piping more than 5 feet outside the building walls shall comply with Section 02510 WATER DISTRIBUTION SYSTEM.

### 2.2.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA ANSI/AWWA C110/A21.10. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA ANSI/AWWA C111/A21.11.

### 2.2.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

## 2.3 ABOVEGROUND PIPING SYSTEMS

Aboveground piping shall be steel.

### 2.3.1 Steel Piping System

#### 2.3.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black galvanized where indicated as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

#### 2.3.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

#### 2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service

and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.3.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type. Bolts shall be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

#### 2.3.2 Copper Tube Systems

##### 2.3.2.1 Copper Tube

Copper tube shall conform to ASTM B 88, Types L and M.

##### 2.3.2.2 Copper Fittings

Cast copper alloy pressure fittings shall conform to ASME B16.18 and wrought copper and bronze pressure fittings shall conform to ASME B16.22.

##### 2.3.3 NOT USED

##### 2.3.4 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized involved.

##### 2.3.5 Valves

###### 2.3.5.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

###### 2.3.5.2 Check Valve

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plates, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

#### 2.4 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

#### 2.5 WATER MOTOR ALARM ASSEMBLY

Assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 3/4 inch galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 1 inch galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

## 2.6 ALARM INITIATING AND SUPERVISORY DEVICES

### 2.6.1 NOT USED

### 2.6.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

### 2.6.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.7 FIRE DEPARTMENT CONNECTION

Fire department connection shall be projecting type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish.

The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

## 2.8 SPRINKLERS

Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Sprinklers with internal O-rings shall not be used.

### 2.8.1 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 1/2 inch or 17/32 inch orifice.

### 2.8.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed type with nominal 1/2 inch or 17/32 inch orifice. Pendent sprinklers shall have a polished chrome finish.

### 2.8.3 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a brass finish. Sidewall sprinkler shall be the quick-response type.

## 2.9 DISINFECTING MATERIALS

### 2.9.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

### 2.9.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

## 2.10 ACCESSORIES

### 2.10.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

### 2.10.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

### 2.10.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

### 2.10.4 NOT USED

### 2.10.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

## PART 3 EXECUTION

### 3.1 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 231C.

### 3.2 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

#### 3.2.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection of the piping system shall be provided in accordance with NFPA 13 and Appendix A, with the exception that the "Earthquake Zones" map of Appendix A shall not apply to this project. Seismic protection shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required in NFPA 13 for protection of piping against damage from earthquakes. Branch lines shall be equipped with sway braces at the end sprinkler head and at intervals not exceeding 30 ft.

#### 3.2.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

#### 3.2.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

#### 3.2.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

##### 3.2.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

#### 3.2.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

#### 3.2.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

#### 3.2.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

#### 3.2.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide

required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07840 FIRESTOPPING. In penetrations which are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement which will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

### 3.2.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

### 3.2.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

### 3.2.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

### 3.2.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

### 3.2.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

## 3.3 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 02510 WATER DISTRIBUTION SYSTEM.

### 3.4 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

### 3.5 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM. All wiring for supervisory and alarm circuits shall be #14 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

### 3.6 NOT USED

### 3.7 FIELD PAINTING AND FINISHING

Field painting and finishing are specified in Section 09900 PAINTING, GENERAL.

### 3.8 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.8.1 Underground Piping

##### 3.8.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

##### 3.8.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

#### 3.8.2 Aboveground Piping

##### 3.8.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

#### 3.8.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

#### 3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

#### 3.9 FINAL ACCEPTANCE TEST

Final acceptance test shall be witnessed by the Fort Dix Fire Prevention Bureau. A technician employed by the installing Contractor shall be present for the final tests and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

-- End of Section --

## SECTION 13977

## BLAST RESISTANT DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 318/318R (1995) Building Code Requirements for Structural Concrete & Commentary

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA Std 9 (1990) Load Ratings and Fatigue Life for Ball Bearings

ABEMA Std 11 (1990) Load Ratings and Fatigue Life for Roller Bearings

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04 (1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AISC LFRD, Vol I (1995) Manual of Steel Construction Load & Resistance Factor Design, Vol 1 - Structural Members, Specifications and Codes

AISC LFRD, Vol II (1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II - Structural Members, Specifications

AISC ASD Manual (1989) Manual of Steel Construction Allowable Stress Design

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-02 (1996) Specification & Commentary for the Design of Cold-Formed Steel Structural Members (Part V of the Cold-Formed Steel Design Manual)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153 (1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 242/A 242M (1993a) High-Strength Low-Alloy Structural Steel

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1996) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 354	(1995) Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A 366/A 366M	(1996) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 449	(1993) Quenched and Tempered Steel Bolts and Studs
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1993) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(1994) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 534	(1994) Carburizing Steels for Anti-Friction Bearings
ASTM A 563	(1994) Carbon and Alloy Steel Nuts
ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M	(1994c) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 574	(1992a) Alloy Steel Socket-Head Cap Screws
ASTM A 588/A 588M	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1996) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1996) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 611	(1996) Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel

## Bars for Concrete Reinforcement

ASTM A 618	(1993; R 1995) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(1993) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 706/A 706M	(1995b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 715/A 715M	(1996) Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled, and Steel Sheet, Cold-Rolled, High-Strength, Low-Alloy, with Improved Formability
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(1996) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM E 90	(1996) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 568	(1995) Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F 835	(1993) Alloy Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F 883	(1990) Padlocks

## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A5.4	(1992) Stainless Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(1996) Structural Welding Code - Steel
AWS D1.3	(1989) Structural Welding Code - Sheet Steel
AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA ANSI/BHMA A156.3	(1994) Exit Devices
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BHMA ANSI/BHMA A156.4	(1992) Door Controls - Closers
BHMA ANSI/BHMA A156.8	(1994) Door Controls - Overhead Stops and Holders
BHMA ANSI/BHMA A156.13	(1994) Mortise Locks & Latches
BHMA ANSI/BHMA A156.20	(1996) Strap and Tee Hinges and Hasps

## MILITARY SPECIFICATIONS (MS)

MS MIL-H-29181	(Rev B) Hasp, High Security, Shrouded, for High and Medium Security Padlock
MS MIL-H-43905	(Rev C) Hasps, High Security Padlocks
MS MIL-P-43607	(Rev G; Am 4) Padlock, Key Operated, High Security, Shrouded Shackle

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 80A	(1996) Protection of Buildings from Exterior Fire Exposures
NFPA 101	(1997) Life Safety Code
NFPA 252	(1995) Fire Tests of Door Assemblies

## 1.2 DESCRIPTION

[Structural steel doors shall be [flush mounted in frames] [or] [surface mounted] [as indicated].] [Reinforced concrete doors shall be surface mounted.] [Hollow metal doors shall be flush mounted in frames and shall be of unitized grid construction with two face sheets.] Doors shall be the manually operated, side hinged, swinging type. Each door assembly shall include the door, frame, anchors, hardware, and accessories and shall be provided by a single manufacturer. Frames and anchors shall be capable of transferring blast and rebound reactions to the adjacent supporting structure. Resistance to blast shall be demonstrated either by design calculations or tests on prototype door assemblies.

## 1.2.1 Design Requirements

## 1.2.1.1 Static Material Strength

The static values for minimum yield strength (or yield point) and (ultimate) tensile strength for steel shall be obtained from the applicable material specification. For tensile strength specified in terms of a tensile strength range, the lowest tensile strength specified shall be selected for design. Structural steel having a minimum static yield strength (or yield point) less than 50 ksi [and Grade 60 reinforcing bars] shall be designed using an average yield strength computed as 1.1 times the minimum static yield strength or yield point. When the minimum static yield for structural steel exceeds 50 ksi, the average yield strength shall be taken as equal to the minimum static yield strength or yield point without increase. [The in-place compressive strength of concrete shall be computed by adding [0.5] [\_\_\_\_\_] ksi to the specified compressive strength to reach the average compressive strength and then multiplying by [1.1] [\_\_\_\_\_] to account for age effects.] [The average yield stress for steel sheet and strip shall be computed as 1.21 times the static yield point.]

## 1.2.1.2 Dynamic Material Strength

The dynamic material strength shall be computed by applying a dynamic increase factor that accounts for the increase in material strength due to strain rate effects. The dynamic increase factor for structural steel in flexure shall be applied to the average yield strength and shall be [1.29] [\_\_\_\_], [1.19] [\_\_\_\_], and [1.09] [\_\_\_\_] for structural steel having a minimum yield strength (or yield point) of 36, 50, and 100 ksi, respectively. The dynamic increase factor for structural steel having a minimum yield strength (or yield point) between these values shall be obtained by interpolation. Optionally, for structural steel in these yield ranges, the dynamic increase factor shall be determined by a detailed analysis that accounts for the time to yield. The dynamic increase factor for structural steel having a minimum yield exceeding 100 ksi shall be 1.0. [The dynamic increase factor for Grade 60 flexural reinforcing bars shall be [1.17] [\_\_\_\_] applied to the average yield strength. The dynamic increase factor for concrete used in flexure shall be [1.19] [\_\_\_\_] applied to the in-place compressive strength. Optionally, the dynamic increase factor applied to flexural reinforcing bar yield and concrete compressive strength shall be determined by a detailed analysis that accounts for the time to steel yield and time to ultimate concrete strength.] [The dynamic increase factor for steel sheet and strip used in flexure shall be 1.1 applied to the average yield stress.]

#### 1.2.1.3 Structural Member Design

[Structural steel section properties for rolled shapes shall be obtained from AISC LFRD, Vol I, AISC ASD Manual, or steel manufacturers' catalogs. The plastic moment capacity for single plate sections and sections built up from plates and shapes shall be computed as the average of the elastic and plastic section modulus multiplied by the dynamic yield strength, unless otherwise approved. Shear, welds, local buckling, and web crippling of structural steel shall be designed in accordance with AISC LFRD, Vol II, the plastic design provisions of AISC-04, or by other approved methods except that for blast design, the load factors and resistance factors shall be equal to 1.0 and the dynamic yield strength shall be substituted for the static yield stress.] [Nominal reinforcing bar designations, weights, and dimensions shall be obtained from ACI 318/318R or the reinforcing bar specification. The moment of inertia of the reinforced concrete cross section used to determine the elastic deflection shall be the average of the moment of inertia of the gross section and the moment of inertia of the cracked section. The resistance of the reinforced concrete section shall be computed in accordance with ACI 318/318R or other approved methods except that for blast design, the load and resistance factors shall be equal to 1.0 and the dynamic reinforcing bar yield strength and dynamic ultimate concrete strength shall be substituted for the static strength values.] [Hollow metal doors shall be designed in accordance with AISI-02 except that for blast design, the dynamic yield strength shall be substituted for the static yield point.]

#### 1.2.1.4 Dynamic Analysis and Deformation

The door shall be designed using an equivalent single degree of freedom or other approved dynamic analysis method. The maximum door deformation shall be selected by the door manufacturer except that the maximum deformation in flexure shall not exceed the deformation limits specified or indicated. The deformation of structural steel members having a minimum yield strength or yield point greater than 65 ksi shall not exceed the elastic deflection. [Increased resistance due to strain hardening of structural steel in flexure can be used when the ductility ratio exceeds 10 or when otherwise approved.] [The ductility ratio for flexural members in hollow metal doors shall not exceed 1.0.]

#### 1.2.1.5 Rebound Resistance

Rebound resistance shall be the specified or indicated percentage of the

door resistance at initial peak response.

### 1.2.2 Blast Effects

#### 1.2.2.1 Overpressure

The spatial distribution of overpressure shall be uniform unless otherwise specified or indicated. [For overpressure specified or indicated without duration, the overpressure waveform shall have a zero rise time and infinite duration.] [For overpressure specified or indicated with duration only, the waveform shall be a triangle with a zero rise time.] [Special waveforms are indicated.]

#### 1.2.2.2 Overpressure Direction

[For overpressure identified as seating and for overpressure directions not otherwise specified or indicated, the positive phase overpressure shall be in the direction that causes the door to seat toward the frame.] [For overpressure identified as unseating, the positive phase overpressure shall be in the direction that causes the door to unseat away from the frame.]

#### 1.2.2.3 Fragment Resistance

For doors specified or indicated to resist fragments, the door and the door and frame interface shall be designed to prevent fragment perforation and the latches and latching mechanism shall be shielded from fragment damage. The fragment impact point shall be anywhere on the door and frame face exposed to overpressure.

### 1.2.3 Blast Door Operation

The force required to set the door in motion shall be measured from the 90-degree open position, and the force required to engage and release the latches shall be measured at the latch handle with the door in the normal closed position.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Blast Resistant Door; GA.

Data on standard blast doors consisting of catalog cuts, brochures, circulars, specifications, and product data that show complete dimensions and completely describe overpressure ratings, rebound ratings, doors, frames, anchors, hardware, and accessories.

Contractor Design Calculations; GA.

Detailed structural analysis and design calculations demonstrating resistance to blast when blast resistance is not demonstrated by prototype tests. Design calculations shall demonstrate adequacy under the blast effects specified or indicated. Design calculations shall include a sketch of the overpressure waveform; dimensioned sketches of blast resisting elements such as door members, frame members, latches, and hinges; section properties for blast resisting members including built-up sections; the standard under which steel is produced; static and dynamic material strength properties; the resistance, stiffness, mass, elastic natural period, and elastic deflection for flexural members; and the peak deflection, peak support rotation, and time to peak deflection for door

members in flexure. Design calculations shall cover initial response, rebound, and all secondary items such as shear, welds, local buckling, web crippling, hinges, and latches.

Test on Prototype Door; GA.

Certified test reports demonstrating blast resistance. Test reports shall include the name and location of the testing agency or laboratory, a description of the testing apparatus, the date of the tests, a description of the door specimen tested, descriptions of loadings, and the value of measured peak door deflection and peak permanent set. Test reports shall include analysis and interpretation of test results.

#### SD-04 Drawings

Contractor Design of Blast Resistant Doors; GA.

For special doors or standard doors with appreciable modifications, detailed fabrication and assembly drawings indicating the door location and showing dimensions, materials, fabrication methods, hardware, and accessories in sufficient detail to enable the Contracting Officer to check compliance with contract documents. Weld symbols used shall conform to AWS A2.4. These drawings need not be submitted for standard doors for which manufacturer's catalog data is submitted.

#### SD-06 Instructions

Blast Resistant Door; FIO.

Manufacturer's instructions for installation and field testing.

#### SD-08 Statements

Manufacturer's Field Service; FIO.

Information describing training to be provided, training aids to be used, and background data on the personnel conducting the training.

#### SD-09 Reports

Blast Door Shop and Field Operating Tests; GA.

Shop and field operating test reports that include values for opening and closing forces and times, forces required to operate latches, and a description of all operating tests performed.

Fire Rated Blast Door; GA.

In lieu of a UL listing for fire door assemblies, a letter may be submitted by the testing laboratory which identifies the submitted product by manufacturer and type or model and certifies that it has tested a sample assembly and issued a current listing.

#### SD-13 Certificates

Certificates of Compliance; GA.

Steel mill reports covering the number, chemical composition, and tension properties for structural quality steels. When blast resistance is demonstrated by calculations, a certificate stating that the door assembly provided was manufactured using the same materials, dimensions, and tolerances shown in the calculations. When blast resistance is demonstrated by prototype testing, a certificate stating that door and frame provided was manufactured using the same materials, dimensions, and tolerances as the tested prototype and listing the hardware and frame

anchors required to achieve blast resistance. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturer and shall identify the door assembly and date of shipment or delivery to which the certificate applies.

Fire Rated Blast Door; GA.

Certificate of inspection conforming to NFPA 80, NFPA 80A, and NFPA 101 for fire doors exceeding the size for which label service is available.

Thermal Insulated Blast Door; GA.

Sound Rated Blast Door; GA.

Certification or test report for [thermal insulated] [sound rated] doors listing the type of hardware used to achieve the rating.

#### SD-19 Operation and Maintenance Manuals

Blast Resistant Door; FIO.

Information bound in manual form consisting of manufacturer's safety precautions, preventative maintenance and schedules, troubleshooting procedures, special tools, parts list, and spare parts data. All material shall be cross referenced to the door designations shown on the drawings.

### 1.4 QUALIFICATIONS

Welders, welding operators, and weld inspectors shall be qualified in accordance with AWS D1.1 [except that] [welders performing arc welding of steel sheet and strip shall be qualified in accordance with AWS D1.3] [and] [welders and weld operators performing welding of reinforcing bars shall be qualified in accordance with AWS D1.4].

### 1.5 DELIVERY AND STORAGE

Door assemblies delivered and placed in storage shall be stored with protection from weather and dirt, dust, and contaminants.

### 1.6 WARRANTY

Manufacturer's written warranty covering the blast door assembly for 2 years after acceptance by the Government shall be furnished. Warranty shall provide for repair and replacement of the blast door assembly and individual hardware and accessory items in the event of malfunction due to defects in design, materials, and workmanship except that the warranty need not cover finishes provided by others.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Only structural quality steel materials for which tension properties have been obtained shall be used to resist blast except that commercial quality steel sheet and strip shall be permitted for prototype tested hollow metal doors. Steel used in the door, door frame, and door frame anchors and nonstainless steel fasteners that resist blast shall be selected from the materials specified.

#### 2.1.1 Concrete and Concrete Reinforcement

Concrete is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcement shall conform to ASTM A 615/A 615M or ASTM A 706/A 706M, Grade 60.

### 2.1.2 Structural Tubing

Structural tubing shall conform to ASTM A 500, ASTM A 501, or ASTM A 618.

### 2.1.3 Structural Steel

Structural steel bars, plates, and shapes shall conform to ASTM A 36/A 36M, ASTM A 242/A 242M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Quenched and tempered steel plate shall conform to ASTM A 514/A 514M.

### 2.1.4 Steel Sheet and Strip

Steel sheet and strip shall conform to ASTM A 366/A 366M; ASTM A 653/A 653M, Grades A, B, C, D, and F; ASTM A 653/A 653M; ASTM A 570/A 570M; ASTM A 606; ASTM A 607; ASTM A 611, Grades A, B, C, and D; ASTM A 715/A 715M, Grades 50 and 60; or ASTM A 792/A 792M, Grades 33, 37, 40, and 50.

### 2.1.5 Fasteners

Steel studs and bolts shall conform to ASTM A 307, ASTM A 325, ASTM A 354, ASTM A 449, ASTM A 490, or ASTM A 687 as applicable. Steel nuts shall conform to ASTM A 563. Hardened circular, beveled, and clipped washers shall conform to ASTM F 436. Steel hex cap screws shall conform to ASTM F 568. Steel socket-headed cap screws shall conform to ASTM A 574. Steel button and flat-headed countersunk cap screws shall conform to ASTM F 835.

## 2.2 HARDWARE

### 2.2.1 Hinges

#### 2.2.1.1 General Requirements

Hinges shall be specially manufactured to support the door and to resist any blast induced loading. The number of hinges shall be determined by the blast door manufacturer. Welds used in hinges shall be continuous. Hinges shall be attached to the door and frame using mechanical fasteners except that full surface hinges for doors with locks shall be attached to the door and frame by welding or approved tamper-resistant mechanical fasteners and hinges for doors with locks shall have approved nonremovable pins. Load ratings and fatigue life for ball and roller bearings shall be determined in accordance with ABEMA Std 9 and ABEMA Std 11 as applicable and, unless otherwise approved, the bearing steel shall conform to ASTM A 534. Hinges shall be capable of operating for the minimum number of cycles specified without failure or excessive wear under the door service loads where one cycle consists of swinging the door back and forth between the normal closed position and the 90-degree open position, where failure or excessive wear means that the latches do not seat properly or the door does not swing smoothly due to hinge failure or wear, and where door service loads consist of the door weight plus any loads produced by hardware. Rolling bearings shall be factory grease lubricated and either sealed or provided with easily accessible lubrication fittings.

#### 2.2.1.1 Hinge Description

[Hinge Type 1 shall be capable of smooth operation for a minimum of 250,000 cycles. This type of hinge shall be provided with structural quality steel pins and leafs and either rolling bearings in both the thrust and radial directions or hardened steel washer (disc) thrust bearings and rolling radial bearings except that rolling thrust bearings and metallic journal radial bearings shall be permitted for hollow metal doors when the specified overpressure is less than 3 psi.] [Hinge Type 2 shall be smooth operating and shall be provided with structural quality steel pins and leafs, steel base washer (disc) thrust bearings, and metallic journal radial bearings or other approved nonrolling type bearings.] [Hinge Type 3 shall be provided with metallic bearings.]

## 2.2.2 Latching System

### 2.2.2.1 Latching Points

The number of latching points shall be determined by the door manufacturer. [For multiple latching points, latching points can be provided at the head, sill, and jambs.] [For jamb latching points, latching points shall be provided at the jambs only.]

### 2.2.2.2 Latching System Operation

Latching systems shall be capable of operating for the same number of cycles specified for the door hinges where one latch operating cycle consists of engaging and releasing using the handle. Latches shall remain engaged until manually released and shall not release under blast loads or rebound. [Manually operated latches shall remain in the released position until manually engaged.] [Self-latching latches shall provide self-activating engagement when the door is swung to the normal closed position.] Handles shall release latches under a clockwise motion.

### 2.2.2.3 Latching Mechanism

[Latching mechanisms and latches for structural steel doors shall be mounted on the seating face of the door.] [Latching mechanisms for hollow metal doors shall be mounted on the seating face of the door and safety covered.] [Unless otherwise approved, latch handle axles (spindles) for [structural steel doors] [and] [reinforced concrete doors] shall extend through the blast load carrying portion of the door and shall be provided with suitable metallic journal bearings.] Latch handle axles shall be manufactured of hardened steel or stainless steel, and axles requiring lubrication shall be provided with easily accessible lubrication fittings.

### 2.2.2.4 Safety Cover

Safety covers shall consist of steel housings that enclose the latching mechanism such that only the operating rods are exposed.

### 2.2.2.5 Cover Plate

Cover plates for structural steel doors shall be manufactured of minimum 1/4 inch thick plate and shall enclose the entire latching mechanism.

### 2.2.2.6 Latches

Latches (latch bolts) shall be manufactured of structural quality steel and the latch bolt throw shall not be less than 3/4 inch. Latch bolts shall be the sliding type in which the latch bolt slides into a matching strike in the door frame [or the lever type in which the latch bolt rotates into a groove in the frame as specified or indicated] [except that latches for doors with [mortise lock and latch sets] [and] [exit devices] shall be the sliding type]. Manually operated latches shall draw the door toward the frame during latching.

### 2.2.2.7 Handle

[Handles for doors without locks shall be manufactured of steel castings, forgings, pipe, round tubing, bar, or plate and shall be one piece or have welded joints except that wheel handles can be manufactured of aluminum castings.] [Handles for doors with mortise lock and latch sets shall be manufactured of [steel castings] [or] [stainless steel].] Latch handles shall be firmly fastened to axles. Lever handles shall be perpendicular to the door edge when latches are engaged. [Single lever handles shall be located at the stile opposite the hinges.] [[Wheel] [and spoke lever] [Spoke lever] handles shall be located approximately halfway between the

stiles.]

### 2.2.3 Mortise Lock and Latch Set

Lever handles shall release latches using a torque not exceeding 27 lb-in.

Latches (latch bolts) shall be located at the stiles and operated from a single lever handle. Only one deadbolt shall be provided. The deadbolt shall be manufactured of structural quality steel and the deadbolt throw shall not be less than 1 inch. Mortise locks shall be provided with armored fronts. The function numbers for mortise locks shall be as defined in BHMA ANSI/BHMA A156.13.

### 2.2.4 Keying

[Keying shall conform to Section 08700 BUILDERS' HARDWARE.] [Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Unless otherwise specified, two change keys shall be provided for each lock.] [Locks shall be furnished with the manufacturer's standard construction key system.]

### 2.2.5 Exit Device

Latches (latch bolts) shall release by depressing the actuation bar using a force of not more than 15 pounds applied perpendicular to the door in the swing direction. The exit device shall [conform to the finish test values specified in BHMA ANSI/BHMA A156.3 and shall be of] [be of stainless steel construction and] plain design with straight, beveled, or smoothly rounded sides, corners, and edges. A touch bar may be provided in lieu of a conventional actuation bar (cross bar). The function numbers for exit devices shall be as defined in BHMA ANSI/BHMA A156.3.

### 2.2.6 Straight Steel Bar Door Pull

Straight steel bar door pulls shall be manufactured of round steel bar. The type furnished shall be [Type I: 1/2 inch diameter, 5 inch grip and 2-1/2 inch projection with 1/2 inch inside bend radiuses] [;] [and] [Type II: 5/8 inch diameter, 12 inch grip and 4 inch projection with 15/16 inch inside bend radiuses] [; and] [Type III: 5/8 inch diameter, 8 inch grip and 4 inch projection with 15/16 inch inside bend radiuses]. Grip and projection dimensions are measured from the bar centerline. The pull shall be attached to the door by fillet welding all around.

### 2.2.7 Padlock

Low security padlocks shall conform to ASTM F 883, Type [PO1] [PO2], Option [\_\_\_\_\_] [and] [\_\_\_\_\_] , Grade [\_\_\_\_\_].

### 2.2.8 Shrouded Padlock

High security padlocks with shrouded shackles shall conform to MS MIL-P-43607.

### 2.2.9 Hasp

Low security hasps shall conform to BHMA ANSI/BHMA A156.20, Grade [1] [2] [3], steel, [safety] [or] [open hinge] type with [adjustable] [,] [or] [swivel] [,] [or] [fixed] staple, [paint finished] [or] [galvanized] [as specified] and screw fastened to the door and frame.

### 2.2.10 High Security Hasp

High security hasps shall conform to MS MIL-H-43905, Style [\_\_\_\_\_] [carbon] [corrosion resistant] steel, attached by [fasteners] [welding].

### 2.2.11 Shrouded Hasp

High security shrouded hasps shall conform to MS MIL-H-29181, Style [1] [or] [2] [as applicable].

#### 2.2.12 Door Stop

Door stops shall be designed to resist the impact of the door. The stop shall not scratch or scar the door finish when the door is opened against the stop.

#### 2.2.13 Surface Door Closer

The surface door closer shall conform to BHMA ANSI/BHMA A156.4. The size and grade shall be selected by the door manufacturer.

#### 2.2.14 Overhead Door Holder

Overhead door holder shall be surface mounted. The holder shall have a spring or other device to cushion the door action and shall limit the door swing at [85] [110] degrees. [The holder shall have a built-in, hold-open capability at the swing limit specified.] [Overhead door holders for hollow metal doors weighing less than 200 pounds shall conform to BHMA ANSI/BHMA A156.8.]

#### 2.2.15 Gasket Seal

Sealed doors shall have the full door perimeter and all door penetrations sealed. Perimeter seals shall be the rubber gasket type. Gaskets shall be removable, capable of sealing the mating surfaces, and resistant to the atmospheric environment. One spare set of gasket seals shall be provided for each door assembly for which gasket seals are specified.

#### 2.2.16 Door Silencer

Rubber door silencers shall cushion the impact of the door against the frame so that steel-to-steel contact is not made during closing.

#### 2.2.17 Optical Device

The optical device (spy hole) shall be wide angle and shall not be breached or dislodged by the specified or indicated blast overpressure. The device shall permit observation from the seating face of the door and shall be located approximately 5 feet above the seating side floor and approximately centered between the stiles.

### 2.3 ACCESSORIES

#### 2.3.1 Subframe

At the Contractor's option, a subframe can be provided and built into the structure prior to installation of the frame. The subframe and subframe anchors shall be capable of transferring blast and rebound reactions to the adjacent structure, and the frame shall be capable of transferring these reactions to the subframe. The subframe shall be fabricated in the same manner specified for the frame.

#### 2.3.2 Nameplate

Each door assembly shall have a permanently affixed nameplate that displays the manufacturer's name, place and year of manufacture, and the applicable peak overpressure, impulse, and rebound rating.

#### 2.3.3 Removable Threshold

The sill shall be flush with the adjacent floor when the threshold is

removed. The removable threshold shall be attached using approved countersunk mechanical fasteners.

#### 2.3.4 Ramp

The ramp shall be structural steel, portable, and weigh not more than [200] [\_\_\_\_\_] pounds. The ramp shall be of sufficient length to extend the full door opening width and shall have the profile indicated. The ramp shall be capable of supporting [a wheel load of [\_\_\_\_\_] pounds] [the wheel load indicated].

#### 2.3.5 Self-Rescue Kit

Self-rescue kits shall contain illustrated instructions, nonadjustable wrenches, screwdrivers, jacks, and all other tools required to open the blast door from the seating face to a width of at least 12 inches. The jack capacity shall not be less than [75,000] [\_\_\_\_\_] pounds. Tools shall be securely mounted in a steel frame using wing nuts or other approved fasteners. The self-rescue kit frame shall be fabricated in the same manner specified for the door frame and shall be securely anchored to the wall at the location indicated or as directed.

### 2.4 FABRICATION

#### 2.4.1 Shop Assembly

Welding shall be in accordance with AWS D1.1 except that arc welding of steel sheet and strip shall be in accordance with AWS D1.3 and welding of concrete reinforcing bars shall be in accordance with AWS D1.4. [Stainless steel shall be welded using electrodes conforming to AWS A5.4.] [Structural steel doors shall be of welded construction.] In order to reduce distortion and residual stresses, a welding sequence shall be used. All welds shall be stress relieved, and welded doors and frames shall be post-weld straightened. Fabricated steel shall be well-formed to shape and size, with sharp lines and angles. Intermediate and corner joints shall be coped or mitered. Exposed welds shall be dressed smooth. [The stiles [and top] of built-up structural steel doors shall be closed using channel shapes or plates.] [When feasible, faceplates for structural steel doors shall be one piece. When one-piece faceplates are not feasible, plates shall be joined using full penetration groove weld butt joints or other approved welds.] [Reinforced concrete doors shall be closed at the edges with structural steel channels or plates and latch housings shall be mortised. Lap splices shall not be used for flexural reinforcing bars.] [Spall plates shall be one piece, covering the entire concrete surface on the seating face of the door, and shall be securely welded to the door edges. Spall plates shall not be less than 1/4 inch thick.] [Faceplated reinforced concrete doors shall be provided with one-piece faceplates on both door faces. Faceplates shall cover the entire concrete surface and shall be securely welded at the door edges. Faceplates shall be not less than 3/8 inch thick.] [Hollow metal door frames shall be pressed steel or structural steel with welded joints. Steel frames or subframes installed in masonry walls shall be provided with adjustable anchors. Hollow metal doors shall be of unitized grid construction with welded grid junctions and shall have flat, one-piece face sheets spot welded to the grid system. The edges of hollow metal doors shall be closed with seams continuously welded. Hollow metal doors shall be neat in appearance, free from warpage and buckle, and suitable reinforcing shall be provided for hardware.]

#### 2.4.2 Mullion

Mullions for double doors shall be fabricated in the same manner specified for frames. [Fixed mullions shall be welded to the frame.] [Removable mullions shall be attached to the frame with mechanical fasteners that are accessible for mullion removal or, in lieu of the removable mullion, an astragal shall be provided at the seating face of the inactive door leaf.]

Doors shall seat directly against the mullion, and the mullion or astragal shall be capable of transferring the door reactions to the frame.

#### 2.4.3 Thermal Insulation

The interior cells between the unitized grid shall be completely filled with thermal insulation material. The U value through the door (panel) shall not exceed [0.24] [\_\_\_\_\_].

#### 2.4.4 Shop Finishing

[Shop priming of steel surfaces shall conform to Section 09900PAINTING, GENERAL except that surfaces that will be embedded in concrete need not be primed and hollow metal doors shall be either dipped in primer after welding is completed, or exposed surfaces shall be primed and interior surfaces coated with an approved rust inhibitor]. [Galvanizing of doors and frames shall conform to ASTM A 123 or other approved methods. Surfaces that will be embedded in concrete need not be galvanized and the interior of hollow metal doors may be treated with an approved rust inhibitor in lieu of galvanizing. Galvanizing of exposed portions of concrete anchors, nonstainless steel fasteners, and hardware other than factory finished hardware shall conform to ASTM A 153 or other approved methods.]

#### 2.4.5 Clearance

[The clearance between the seated steel surfaces of structural steel doors and frames shall not exceed 1/16 inch.] [The lateral clearance between flush mounted structural steel doors and frames shall not exceed [1/4] [\_\_\_\_\_] inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed [1/2] [\_\_\_\_\_] inch.] [The lateral clearance between hollow metal doors and frames shall not exceed 1/8 inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed 1/4 inch.] The clearance between the door bottom and threshold shall not exceed 3/4 inch.

### 2.5 BLAST DOOR ASSEMBLIES

#### 2.5.1 Door [\_\_\_\_\_] ; Steel

##### 2.5.1.1 Type

Type shall be [structural steel] [double structural steel door with [fixed] [or] [removable] mullion] [,] [galvanized] [,] [and] [fire-rated].

##### 2.5.1.2 Overpressure

Overpressure shall be [\_\_\_\_\_] psi [with a [\_\_\_\_\_] millisecond duration] in the [seating] [unseating] direction [and [\_\_\_\_\_] psi [with a [\_\_\_\_\_] millisecond duration] in the unseating direction]. The [shock and gas overpressure] [overpressure] waveform shall be as indicated.

##### 2.5.1.3 Fragment

[The fragment shall be [\_\_\_\_\_] ounces with a velocity of [\_\_\_\_\_] fps and impact [normal to][at an angle of [\_\_\_\_\_] degrees measured from] the door face.] [Protection from fragments shall be provided by steel plate not less than [\_\_\_\_\_] inches in thickness.]

##### 2.5.1.4 Rebound

Rebound resistance shall be [50] [100] [\_\_\_\_\_] percent.

##### 2.5.1.5 Deformation Limits

The ductility ratio shall not exceed [10] and the support rotation shall not

exceed 2 degrees] [20 and the support rotation shall not exceed 12 degrees].

#### 2.5.1.6 Hardware

Full surface hinges shall be Type [1] [2] [3]. [Multiple] [Jamb] latching points and [multiple lever handles] [,] [or] [a single lever handle] [,] [or] [a wheel handle] [,] [or] [a spoke lever handle] operated from [the seating face] [and] [opposite the seating face] with [manual] [self-latching] latch engagement and [either] sliding [or lever] latch bolts shall be provided. The latching mechanism shall be [safety] [or] [cover] plated. A [Type [I] [II] [III] straight steel bar door pull] [,] [and] [padlock] [shrouded padlock] [,] [and] [hasp] [high security hasp] [shrouded hasp] [,] [and] [door stop] [,] [and] [surface door closer] [overhead door holder] [,] [and] [gasket seals] [door silencer] [,] [and] [optical device] shall be provided.

#### 2.5.1.7 Operating Forces

[Maximum operating forces shall be [30] [40] [\_\_\_\_\_] pounds to set the door in motion and [20] [\_\_\_\_\_] pounds to swing the door. Maximum force to engage and release latches shall be [20] [30] [40] [\_\_\_\_\_] pounds.] [Operating forces shall conform to NFPA 101.]

#### 2.5.1.8 Accessories

A [removable threshold] [or] [ramp] [and] [self-rescue kit] shall be provided.

#### 2.5.2 Door [\_\_\_\_\_] ; Concrete

##### 2.5.2.1 Type

Type shall be [reinforced concrete] [double reinforced concrete] door with [fixed] [or] [removable] [mullion] [and] [with] [spall plate] [faceplates].

##### 2.5.2.2 Overpressure

Overpressure shall be [\_\_\_\_\_] psi [with a [\_\_\_\_\_] millisecond duration] in the [seating] [unseating] direction [and [\_\_\_\_\_] psi with a [\_\_\_\_\_] millisecond duration in the unseating direction]. The [shock and gas overpressure] [overpressure] waveform shall be as indicated.

##### 2.5.2.3 Fragment

[The fragment shall be [\_\_\_\_\_] ounces with a velocity of [\_\_\_\_\_] fps and impact [normal to][at an angle of [\_\_\_\_\_] degrees measured from] the door face.] [The nominal door thickness shall not be less than [4] [8] [\_\_\_\_\_] inches.]

##### 2.5.2.4 Rebound

Rebound resistance shall be [20] [100] [\_\_\_\_\_] percent.

##### 2.5.2.5 Deformation Limits

[The door support rotation shall not exceed [1 degree] [2 degrees] for one-way acting doors without stirrups, [2] [4] degrees for one-way acting doors with stirrups, and [2] [8] degrees for two-way acting doors.] [The support rotation shall not exceed 2 degrees except that the support rotation for one-way acting doors without stirrups shall not exceed 1 degree.]

##### 2.5.2.6 Hardware

Hinges shall be Type 2. [Multiple] [Jamb] latching points and multiple

lever handles operated from [the seating face] [and] [opposite the seating face] with manual latch engagement and lever latch bolts shall be provided.

Type [I] [II] [III] straight steel bar door pull [,] [and] [padlock] [shrouded padlock] [,] [and] [hasp] [high security hasp] [shrouded hasp] [,] [and] [door stop] [,] gasket seals [, and optical device] shall be provided.

#### 2.5.2.7 Operating Forces

Maximum operating forces shall be [40] [\_\_\_\_\_] pounds to set the door in motion and [20] [\_\_\_\_\_] pounds to swing the door. Maximum force to engage and release latches shall be [30] [\_\_\_\_\_] pounds.

#### 2.5.2.8 Accessories

A [removable threshold] [ramp] [and] [self-rescue kit] shall be provided.

#### 2.5.3 Door [\_\_\_\_\_] ; Metal

##### 2.5.3.1 Type

Type shall be [hollow metal] [double hollow metal door with a [fixed] [or] [removable] mullion] [,] [galvanized] [ ;] [and] [thermal insulation] [sound-rated to STC [40] [\_\_\_\_\_] ] [, and] [fire-rated].

##### 2.5.3.2 Overpressure

Overpressure shall be [\_\_\_\_\_] psi in the [seating] [unseating] direction [and [\_\_\_\_\_] psi in the unseating direction].

##### 2.5.3.3 Rebound

Rebound resistance shall be [50] [100] [\_\_\_\_\_] percent.

##### 2.5.3.4 Hardware

[Full surface] [Mortise] hinges shall be Type [1] [2] [3]. [[Multiple] [Jamb] latch points and [multiple lever handles] [or] [a single lever handle] operated from the [seating face] [and] [opposite the seating face] with [manual] [self-latching] latch engagement and [either] sliding [or] lever] latch bolts shall be provided.] [Exit device with [multiple latch points] [jamb latch points] [and with function [\_\_\_\_\_] ] shall be provided.] [Mortise lock and latch set [with function [\_\_\_\_\_] ] shall be provided.] [A [padlock] [and] [hasp] [,] [and] [door stop] [,] [and] [surface door closer] [overhead door holder] [,] [and] [gasket seals] [door silencer] [,] [and] [optical device] shall be provided.]

##### 2.5.3.5 Operating Forces

[Maximum operating forces shall be [20] [\_\_\_\_\_] pounds to set the door in motion and [15] [\_\_\_\_\_] pounds to swing the door.] [Operating forces shall conform to NFPA 101.] Maximum force shall be [20] [\_\_\_\_\_] pounds to engage and release latches.

##### 2.5.3.6 Accessories

A [removable threshold] [or] [ramp] shall be provided.

#### 2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

##### 2.6.1 Prototype Static Test

Static tests on prototype door assemblies shall demonstrate that the door will resist the blast overpressure. Static tests will be accepted only if the door and frame proposed are manufactured using the same materials,

dimensions, and tolerances as those in the prototype static test and the static overpressure used in the test is at least two times the blast overpressure. Static test reports shall be supplemented with calculations that demonstrate rebound resistance when rebound is not tested.

#### 2.6.2 Prototype Blast Test

Blast tests on the prototype door assembly shall demonstrate that the door will resist the overpressure waveform. Blast tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype blast tests. The rise time of the test waveform shall be zero or subject to approval. [For an overpressure with infinite duration, the overpressure used in the test shall be not less than that specified or indicated for a duration equal to at least five times the natural period of the door and the test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance.] [For overpressure with finite duration, the overpressure waveform used in the test shall exceed the overpressure waveform in both peak overpressure and impulse and the blast test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance when the positive phase waveform duration in the test exceeds the positive phase duration specified or indicated.]

#### 2.6.3 Shop Operating Test

Prior to shipment, each door assembly shall be fully erected in a supporting structure and tested for proper operation. Such testing shall include opening, closing, and operating all moving parts to ensure smooth operation and proper clearance, fit, and seating. The operating forces and opening and closing times shall be determined. The Contracting Officer shall be notified at least [7] [\_\_\_\_\_] calendar days prior to the start of testing and [all doors] [door [\_\_\_\_\_] [,] [\_\_\_\_\_] [,] [and] [\_\_\_\_\_] ] shall be tested in the presence of the Contracting Officer. A test report shall be prepared and [three] [\_\_\_\_\_] copies furnished within [7] [\_\_\_\_\_] calendar days after testing.

#### 2.6.4 Air Leakage Test

Each door assembly for which [door seals] [or] [thermal insulation] [are] [is] specified shall be factory tested for air leakage rate in accordance with ASTM E 283. The rate of air leakage per unit length of crack shall not exceed [0.20] [\_\_\_\_\_] cfm using a pressure difference of [1.57] [\_\_\_\_\_] psf. Prototype tests can be substituted for door assembly tests when the prototype door, frame, and hardware tested are equivalent to that provided or when otherwise approved.

#### 2.6.5 Sound Rating Test

The sound transmission class (STC) rating shall be determined in accordance with ASTM E 90.

#### 2.6.6 Fire Rating Test and Inspection

Fire-rated door assemblies shall bear the listing identification label of the UL, or other nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. Doors exceeding the size for which listing label service is offered shall be inspected in accordance with NFPA 80, NFPA 80A, and NFPA 101.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors and frames shall be installed in accordance with the manufacturer's

written instructions. [Concrete shall be placed in reinforced concrete doors using the door manufacturer's standard forms.] [Pressed steel frames for hollow metal doors shall be fully grouted.] Exposed surfaces shall be finish painted in accordance with Section 09900 PAINTING, GENERAL. Galvanized surfaces damaged prior to final acceptance shall be repaired in accordance with ASTM A 780 to the same thickness as the original galvanizing.

### 3.2 TESTS

After installation is completed, each door shall be field tested for operation, clearance, fit, and seating by operating the door and hardware through at least 10 operating cycles. Door and hardware operation shall be tested using the forces specified. Personnel and equipment required to perform field testing shall be provided by the Contractor. Unless waived, all field tests shall be performed in the presence of the Contracting Officer. After testing is completed, test reports shall be prepared and [three] [\_\_\_\_\_] copies furnished.

### 3.3 MANUFACTURER'S FIELD SERVICE

Installation and testing of door assemblies shall be under the supervision of the door manufacturer's erection engineer. Upon completion of the work, and at a time designated by the Contracting Officer, the services of one engineer and other technical personnel as required shall be provided for a period of not less than [4] [\_\_\_\_\_] hours to instruct Government personnel in the operation and maintenance of the blast doors and all other items furnished under this specification section. The instructions shall also include use of the operation and maintenance manual. The instructions shall include videotapes. An instruction outline and procedure shall be submitted and approved prior to scheduling the instruction. One copy of all instruction material shall be provided at the time of instruction.

-- End of Section --

## SECTION 15010

## BASIC MECHANICAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Basic Mechanical requirements that are applicable to all Division 15 sections in addition to Division 0 - Contract Requirements and Division 1 - General Requirements.
- B. Mechanical work covered by all sections within DIVISION 15 - MECHANICAL of these Specifications, including but not limited to:
  - 1. Heating, ventilating, air conditioning and refrigeration systems and equipment.
  - 2. Plumbing systems and equipment.
  - 3. Fire protection systems and equipment.
  - 4. Controls systems

## 1.2 RELATED SECTIONS

- A. Division 0 - Contract Requirements
- B. Division 1 - General Requirements
- C. Division 3 - Concrete
- D. Division 9 - Finishes
- E. Division 11 - Equipment
- F. Division 12 - Furnishings
- G. Division 13 - Special Construction
- H. Division 14 - Conveying Systems
- I. Division 16 - Electrical
- J. Divisions 1 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS: These shall apply to all work included in this section. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this and the other sections of Division 15.
- K. This section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
  - 1. Reference Standards, Codes and Fees
  - 2. Quality Assurance
  - 3. Submittals
  - 4. Maintenance Manuals
  - 5. Job Conditions

6. Accuracy of Data and Drawings
7. Electrical Requirements for Mechanical Equipment
8. Coordination Drawings
9. Record Documents
10. Identification
11. Fire-Stop Materials
12. Rough-ins
13. Field Tests
14. Excavation and Backfill
15. Adjusting and Cleaning
16. Installation
17. Removal and Relocation of Existing Work
18. Painting

1.3 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall obtain and pay for all licenses and permits required to perform work covered by DIVISION 15 - MECHANICAL, and obtain and pay for all necessary inspections by all applicable authorities.

1.4 CODES AND STANDARDS

Select related codes or standards.

- A. In addition to requirements of Divisions 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS, all work shall be manufactured, installed and labeled in accordance with the applicable provisions of the latest editions of the following codes and standards, including addenda and modifications made by local authorities.

1. Local Codes
2. State Codes
3. Federal Codes
4. ASME Boiler Code
5. AGA - American Gas Association
6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
7. AABC - Associated Air Balance Council
8. NEMA - National Electrical Manufacturer's Association
9. ANSI - American Society National Standards Institute
10. ASME - American Society of Mechanical Engineers
11. NFPA - National Fire Protection Association

12. ARI - Air-Conditioning and Refrigeration Institute
13. UL - Underwriters Laboratories, Inc.
14. BOCA National Codes - Building, Mechanical, Plumbing, Fire Prevention, Existing Structures, Sewage Disposal, Energy, Etc.
15. SBCCI Standard Codes - Building, Mechanical, Plumbing, Fire Prevention, Energy Conservation Etc.
16. Uniform Codes - Building, Mechanical, Plumbing, Fire Prevention, Etc.
17. National Codes - Building Mechanical, Plumbing, Fire Prevention, Etc.
18. ASPE - American Society of Plumbing Engineers.
19. OSHA - Occupational Safety and Health Act.
20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc. 1985 HVAC Duct Construction Standards.

#### 1.5 QUALITY ASSURANCE

- A. The use of manufacturer's names and catalog numbers in these specifications or on the drawings indicates the type, size, rating, capacity, design, quality, or kind of materials required and a closed specification is not intended, and similar and equal products of any reputable manufacturer which will satisfactorily perform the required functions will be acceptable, unless otherwise indicated by the words NO SUBSTITUTES, or unless otherwise specifically stated. The Architect/Engineer reserves the right to reject all materials which he deems not equal to those specified, or which he decides will not satisfactorily perform the required functions.
- B. Supply all equipment and accessories new and free from defects.
- C. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- D. Supply all equipment and accessories in compliance with the applicable standards listed in Article 1.4 of this section and with all applicable national, state, and local codes.
- E. When included, reflected ceiling plan drawings shall govern over mechanical and electrical drawings for location of ceiling-mounted elements.
- F. In addition to all requirements specified hereinafter, each material and equipment item shall have all features as standard with its manufacturer and/or required for the complete operational system.
- G. Capacities, ratings, sizes and other requirements not specified hereinafter shall be as scheduled or otherwise indicated on the drawings.
- H. Should the Trade Contractor at any time discover a discrepancy between engineering and architectural drawings or with respect to a variance of code requirements, he shall notify the Architect/Engineer for clarification and shall

not proceed with the work affected until clarification has been made.

#### 1.6 SUBMITTALS

- A. Submittals and shop drawings shall be submitted in accordance with Divisions 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS and in accordance with the following.
1. Carefully review the requirements of DIVISIONS 0 and 1.
  2. All equipment, material, and manufacturer's literature shall be submitted for approval at one time and in a tabulated high quality 3 ring binder. Control drawings and the controls equipment submittal may be submitted at a later time, but as soon as practical after the contract has been awarded and after the general equipment submittal has been made. However, every attempt shall be made to include the complete controls submittal with the general equipment submitted at one time.
  3. The submittal shall include summary cover sheet(s) and manufacturer's literature under each tab of the submittal binder which together clearly indicate compliance or deviation from the specifications and drawings. Each submittal brochure shall be signed, on the index page, by Contractor. This signature shall indicate the Contractor has examined all data therein and found same to be in order.
  4. Submission material and all shop drawings shall be marked up with the appropriate identification relating the equipment to the drawings. Mark and reference each item on the submittal summary sheet and the manufacturer's literature to the appropriate paragraph number in the specifications. Manufacturer's standard catalogs will not be accepted.
  5. Failure to comply with the above for a complete and clear submittal will result in resubmittal.
  6. A minimum of (7) copies of all submittals shall be provided of which (3) will be returned to the Owner by the Contractor, (2) will be retained by the A/E, and (2) will be available for Contractor's use.
- B. Maintenance Manuals:
1. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for each equipment item. Behind a separate tab for each piece of equipment, provide the following:
    - a. A copy of the equipment submittals and shop drawings as provided in (A) above.
    - b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
    - c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and

- normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions, as applicable.
  - d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - e. Servicing instructions and lubrication charts and schedules.
- 2. Before requesting acceptance of work, furnish the number of printed and bound sets required in DIVISIONS 0 and 1.
  - 3. Detailed and simplified one line, color coded flow and wiring diagrams.
  - 4. Schedule of valve identification.
  - 5. Provide seven copies of all manuals.
- C. Field test report: required by Section 15990 - BALANCING AND TESTING BY INDEPENDENT AGENCY. Provide seven copies.

#### 1.7 JOB CONDITIONS

- A. Examine related work and surfaces before starting work of any section.
  - 1. Report to Architect/Engineer, in writing, conditions which will prevent proper provision of this work.
  - 2. Installed work which interferes with architectural or any other work, or which deviates from drawings and specifications without Architect's prior approval, shall be altered by DIVISION 15 - MECHANICAL, without cost to the Owner, to clear such interferences, or to comply with the drawings and specifications. Interferences or discrepancies which may be discovered or anticipated shall be reported promptly to Architect for his decision before proceeding with the work involved. Architect shall have privilege of making minor changes without additional cost, provided that such changes are made before commencing work on items involved.

#### 1.8 ACCURACY OF DATA AND DRAWINGS

- A. Drawings are generally diagrammatic, and where not dimensioned or detailed, indicate approximate locations of work. Examine carefully existing buildings and structures, existing systems, and all other contract drawings, and install work to conform as nearly as possible to locations and arrangements indicated, with only such minor adjustments as necessary to coordinate work with architectural and other work, and to avoid interferences therewith. All piping and ductwork, offsets, risers, and fittings are not necessarily shown; however, provide these as required by the conditions involved.
- B. Building and structure dimensions: TAKE THESE FROM ARCHITECTURAL AND STRUCTURAL DRAWINGS, AND FROM ACTUAL MEASUREMENTS MADE EACH BUILDING INVOLVED.

#### 1.9 ELECTRICAL CHARACTERISTICS, MOTOR SIZES, MOTOR STARTERS, CONTROLS, AND WIRING

- A. DIVISIONS 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS: These shall apply to the work related in this section.
- B. Motor starters and other electrical control devices: Generally, motor starters for equipment motors shall be furnished by DIVISION 16 - ELECTRICAL; however, this section shall furnish ONLY those motor starters which may be specified hereinafter in this Section. Also, this section shall furnish and install all other electrical control devices required for the Mechanical system, unless otherwise specified.
- C. Installation of electrical devices, EXCEPT those factory mounted on equipment: electrical control devices which require electrical connections ONLY, shall be installed by DIVISION 16 - ELECTRICAL. All control devices which are not factory mounted on the equipment and require piping, linkage, remote bulb, or other mechanical connections as well as electrical connections shall be installed by the Section that furnished the equipment involved, ready for electrical connection.
  - 1. Electric wiring: Division 15 shall perform any and all control and interlock wiring necessary for the operation sequence described in Section [15950] [15951] or on mechanical plans with properly licensed personnel. Any wiring requirements for control devices furnished under Division 15 shall be provided by Division 15. Wiring for control devices not furnished by Division 15 or devices that are factory mounted on mechanical equipment requiring electrical connections only shall be by Division 16. Division 16 shall provide dedicated 120 VAC, 15-20 amp power to designated control panel locations. Exact locations shall be coordinated between Division 15 and 16.
  - 2. All necessary interlocking contacts and remote starting contacts and remote starting devices not installed on local control panels shall be supplied with the starters and it shall be the responsibility of Division 15 to coordinate the number of contacts required. If individual control transformers are required, provide the transformers necessary for the additional power required by auxiliary control devices. This coordination shall occur prior to ordering starters and the cost shall be included in the bid proposal.
  - 3. Control wiring materials and installation shall conform to Division 16 requirements.

#### 1.10 PROJECT RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT RECORD DOCUMENTS." In addition to the requirements specified in Division 1, indicate the following installed conditions:
  - 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
  - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located

(i.e., traps, strainers, expansion compensators, tanks, etc.) Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
5. Contract Modifications, actual equipment and materials installed.
6. These documents shall be prepared in Microstation format and provided with project closeout documentation in disk and hard copy format.

## PART 2 - PRODUCTS

### 2.1 HOUSEKEEPING PADS

- A. Provide 4" concrete pads for all floor mounted mechanical equipment such as circulating pumps, chillers, air handling units, etc. Pad dimensions shall be approximately 2" inches larger than the equipment in the width and depth dimensions. Bevel the edges of the pad to reduce chipping. Refer to section 03300 for concrete specifications.

## PART 3 - EXECUTION

### 3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

### 3.2 FIELD TESTS

- A. All piping shall be free of leaks, and test gauges shall show no loss of pressure for at least 30 minutes, after source of test pressure has been cut off, or as noted. Pipes may be tested in sections as the work progresses. Repair and retest all sections failing to pass tests, as required to obtain approval of tests. No caulking, welding or brazing will be permitted on threaded pipe or fittings to stop leaks. Replace with new material all cracked or otherwise defective pipe and fittings of all types, as approved. Furnish suitable testing equipment, give the Architect/Engineer and all applicable authorities ample advance notice of all proposed tests and readiness of work for inspections, and conduct each test in their presence, as approved. Do not conceal or insulate piping and do not conceal ductwork until all inspections have been made and all required tests have been approved by the Architect/Engineer and all applicable authorities. Submit results for review.
- B. Provide required labor, material, equipment and connections.
- C. Test all piping, EXCEPT as otherwise specified below, as follows: hydrostatic test, at 150 percent of normal operating pressure of piping involved, or 100 psi (690 kpa),

whichever is higher, AFTER removing all air from piping involved in test.

1. Natural gas and fuel oil piping: 50 psi (345 kpa) test using air or inert gas.
  2. Soil, waste, vent roof drainage, and acid waste piping: standard water test, by filling piping with water up to top of vent stack or highest point of piping test section involved, but no section tested with less than a ten foot head with no pressure loss for at least 30 minutes.
  3. Compressed air: air test at 150 percent of normal working pressure of piping involved, or 100 psi (690 kpa), whichever is higher.
  4. Fire protection piping: 200 psi (1380 kpa) two hour duration hydrostatic test, AFTER removing all air from piping involved in test, with pressure gauged at bottoms of standpipes. Conduct this test in presence of authorized representative of the Fire Department having jurisdiction.
  5. Chilled water and heating water piping: Water test at 150% of normal working pressure of piping involved, or 100 psig (690 kpa), whichever is higher.
  6. Test all equipment in accordance with sections specified hereinafter.
- D. Test all ductwork constructed to 2" (500 pa) W.G. class or higher, in accordance with leakage test method recommended in 1985 SMACNA "Duct Construction Standards". After remedying audible leaks, total leakage on system shall not exceed one percent of system total design air flow rate.

### 3.3 EXCAVATION AND BACKFILL

#### A. Excavation, Underground Pipework:

1. Cut trenches to indicated and/or required lines, and to depths which will:
  - a. Provide full length bearing of pipe barrels on firm ground.
  - b. Provide 24 inch (610 mm) MINIMUM earth cover over all pipes outside of buildings and structures.
2. Piping shall be laid on a six inch (152 mm) bed of sand and backfilled with 12 inches (305 mm) of sand in six inch (152 mm) layers.
3. Seat pipe on sand fill as required to facilitate jointing, and to prevent pipe hubs, couplings and valves from bearing on sand before backfilling.
4. Sheet and brace excavations as required to prevent cave-ins and protect personnel and adjacent structures.
5. Where pipelines are below footings, horizontal distance between footings and pipelines shall be as required to provide not steeper than a 1:1 slope from footing bottoms to trench bottoms at all points.

## B. Backfill, Trenches

1. After each pipeline has been laid, tested and approved, thoroughly hand tamp backfill into bell holes, around pipe, and up to six inches (152 mm) above pipe top.
2. Place remaining backfill in 8 inches (203 mm) maximum thickness loose layers, and with pneumatic or other suitable power tampers compact each layer to the backfill density specified in SITEWORK.
3. Backfill materials shall be of the following types:
  - a. Up to six inches (152 mm) above pipe tops: sand, ONLY.
  - b. From six inches (152 mm) above pipe tops up to finished grade or subgrade, as required.
    - (1) Any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following material which are larger than six inches in their greatest dimensions: rock, stone, concrete, asphalt paving, or masonry.
    - (2) Dispose of excavated materials which are not replaced as backfill, as approved.

## C. Excavation and Backfill for Structures Related to Mechanical Work

1. This shall conform to applicable requirements in Division 2 - SITEWORK.

## D. Unsuitable Subsurface Conditions

1. Where excavation bottoms at required elevations are found to be unstable, or where rock, cinders, rubbish, or other deleterious materials are encountered, extend excavations down to firm earth, but at least 6 inches (152 mm) below deleterious materials.
2. Bring excavation bottoms back up to required pipe laying subgrade by backfilling with suitable material, thoroughly compacted in place as specified above.
3. "Suitable material" shall be as specified above.
4. Dispose of excavated unsuitable subgrade materials, as approved.

## E. Warning Tape for Buried Pipeline: Install detectable warning tape directly over every pipeline by burying tape as close to the surface as possible, but no less than 6 inches (152 mm) beneath finished grade.

## 3.4 ADJUSTING AND CLEANING

- A. Flush or blow all welding slag, pipe joint compound, loose scale, and other debris from pipework before connecting equipment thereto.
- B. After systems have been tested and before any field painting is commenced, clean up all work thoroughly. Remove all foreign matter which has accumulated in ducts, casings, enclosures, fixtures, and equipment. Clean and polish all valves, plates, and other surfaces that are not to be

painted, so that they present a new and acceptable appearance.

- C. Put systems in operation, test all fixtures and other equipment, remedy all leaks and defects, make all necessary adjustments, and remove all air from water circulating systems. Adjust all air and water flows to indicated and/or required quantities, and adjust all controls and other items as required to balance system and provide uniform air flows and uniform temperatures in air conditioned areas. Demonstrate that all controls and mechanical equipment function satisfactorily, as specified, as indicated, and as approved.
- D. Sterilization of Domestic Water System: AFTER all water connections have been made to all fixtures and equipment, and BEFORE plumbing system is used by Owner, sterilize entire potable water system as specified below, and submit a written report certifying that this has been done in accordance with the requirements of the State Department of Public Health.
  - 1. Drain entire water system.
  - 2. Refill entire water system with a sterilizing solution of potable water containing at least 50 parts per million of available chlorine.
  - 3. Allow sterilizing solution to remain in water system for at least 24 hours, then drain all sterilizing solution from water system.
  - 4. With potable water, flush all traces of sterilizing solution from entire water system through each fixture and each water outlet.
- E. Strainers and Dirt Pockets: Clean out each of these; REMOVE EACH STRAINER SCREEN FOR CLEANING. Initially install very fine mesh screen for system cleaning and operate System to a minimum of 24 hours. Remove screen, clean it and replace it in system until a clean system is verified. Remove screen and replace with screen at mesh for normal operation.
- F. Circulating Water Systems: Completely drain each of these, and refill with clean water.
- G. Compressed air and medical gas piping shall be cleaned in accordance with the requirements of Section 15400 - COMPRESSED AIR SYSTEM.
- H. After systems have been tested and before putting any part of or the entire system in operation for Owner's beneficial use, insure that all necessary adjustments have been made.
  - 1. Bearings and other items requiring lubrication, except factory permanently lubricated type: lubricate each of these as recommended by its manufacturer; this includes lubricated type plug valves.
  - 2. Belts: adjust each of these to proper tension.
  - 3. Filters: replace each disposable ("throw away") filter with a new clean filter (except blanket roll and high efficiency type). Clean each cleanable filter. NOTE: ALL FILTERS SHALL BE IN PLACE DURING TESTING AND ADJUSTING AND SHALL BE CLEAN.

4. Motor load tests: make an ammeter check of actual running current of each motor in mechanical system under operating conditions. Correct all motors which are found to be overloaded, as approved.

### 3.5 INSTALLATION

- A. General: Sequence, coordinate and integrate the various elements of mechanical systems, materials, and equipment.
- B. Equipment rooms and other areas in which equipment is to be installed have limiting dimensions. Coordinate mechanical systems, equipment, and materials installation with other building components. Install all mechanical work within these areas substantially as indicated, with ample unobstructed access space around each piece of equipment to facilitate proper installation, operation, and maintenance of equipment, and to allow ample space for plumbing, electrical, and other equipment indicated to be installed therein. Minor revisions in layout may be made subject to Architect's approval, but major changes in layout to accommodate proposed equipment which differs substantially from specified equipment in size and arrangement will not be considered. Each bidder shall determine before bidding that equipment upon which he proposes to base his bid will conform to these requirements. Install each equipment item in accordance with its manufacturer's recommendations, and as indicated on the drawings, and/or specified. If the drawings and/or specifications conflict with the manufacturer's recommendations, report this to the Architect/Engineer for his decision before proceeding with the work involved.
- C. Equipment NOT furnished by mechanical section but requiring mechanical connections from other Sections and others furnishing this equipment, determine exact mechanical connection requirements therefor; locations and arrangements of connections indicated for this equipment are APPROXIMATE ONLY.
- D. Arrange for chases, slots and openings in other building components during progress of construction, to allow for mechanical installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- F. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- G. Where installation heights are not detailed or dimensioned, and equipment requires periodic service, verify height with Owner and/or Architect prior to installation, otherwise install to provide the maximum headroom possible.
- H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
- I. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for

ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

- J. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Generally, install pipework and ductwork as follows unless otherwise indicated.
  - 1. Finished areas: conceal pipework and ductwork within pipe chases, above suspended ceiling and within other building construction, in offices, rest rooms, and other finished areas, unless otherwise indicated.
  - 2. Unfinished areas: install above ground pipework and ductwork exposed in areas where pipe chases or suspended ceilings are not indicated or concealing is otherwise impracticable, in mechanical and electrical equipment rooms or storage areas, and other unfinished areas.
  - 3. ALL areas: install pipework and ductwork parallel or at right angles with beams, walls, ceilings, and other building lines, in straight lines between required direction changes, with vertical runs plumb. Install exposed pipework and ductwork as close as practicable to walls, columns, ceilings, and overhead construction, and to provide maximum headroom and minimum interference with usable building space.

### 3.6 PAINTING

- A. All surfaces shall be left clean and free from oil.
- B. All equipment shall be factory prime coated and painted; however, the following may be shop prime coated and made ready for painting:
  - 1. Tanks.
  - 2. Structural supports and frames.
- C. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.
- D. Uncoated Hangers, Supports, Rods, and inserts shall be prime coated.
- E. Exposed, uninsulated black steel piping, pipe supports, and pipe braces shall be prime coated.
- F. All ductwork, conduit, insulation, pipe, and structures visible through grilles and diffusers shall be painted flat black.
- G. Marred surfaces of prime coated or factory painted surfaces shall be painted and/or primed to match adjacent coat.
- H. Provide enamel paint where specified.
- I. Refer to Section 09900 for Painting.

### 3.7 IDENTIFICATION OF VALVING AND EQUIPMENT

- A. Identify valves, (including main pipe sectionalizing valves and branch valves) except those on or within hand reach of

equipment controlled thereby with a minimum 1-1/2 inch (38 mm) diameter round brass or aluminum tag stamped with 1/4 inch (6 mm) (minimum) height letters designating material controlled by valve, and attached to valve body with 18 (minimum) gauge (1.3 mm) solid copper or galvanized steel wire. Submit a typed valve identification schedule with the operating instructions and parts list submittal described above under article 1.12 SUBMITTALS AND SHOP DRAWINGS.

- B. Equipment: Label each major mechanical equipment item (such as AHU, pump, fan, condensing unit, boiler, water heaters, etc.) with nameplate engraved with equipment designation and number, and securely attached to equipment.

### 3.8 IDENTIFICATION OF PIPING

- A. Identify piping with self-sticking vinyl cloth pipe markers and pipe marker arrows, each sized as recommended by marker manufacturer for outside diameter of pipe (including pipe insulation) labeled therewith. Marker background colors shall conform to OSHA, NFPA and ANSI pipe identification standards as scheduled in Table (I). Each pipe marker shall be lettered to indicate the material contained in the pipeline involved and arrows shall indicate direction of material flow in the pipelines.
- B. Provide a full color piping Identification Schedule indicating material type within pipe and its corresponding color coding.
- C. Locate Identification As Follows:
1. Mechanical Equipment Rooms:
    - a. Within 1'-6" (0.46m) of each valve or valve assembly.
    - b. Within 3'-0" (0.92m) of each 90 deg (1.57 Rad) elbow, connection to equipment or vessel, point where pipe enters shafts and pierces outside walls.
    - c. On not over 20'-0" (6.1 m) intervals along all exposed piping.
  2. Above Suspended Ceilings:
    - a. Within 1'-6" (0.46 m) of each valve or valve assembly.
    - b. At tees within 3'-0" (0.92 m) of both main and branch.
    - c. Within 3'-0" (0.92 m) of each 90 deg (1.57 Rad) elbow.
  3. Piping Concealed in Chases or Shafts:
    - a. Each pipe visible through an access door or panel.
  4. Piping Exposed in Rooms Other than Mechanical Equipment Areas:
    - a. Omit identification of piping, 1/2" (13 mm) and smaller, exposed at connections to equipment or plumbing fixtures.
    - b. With the above exception, identify at not less than (1) point each piping run visible in each room with identification on not over 20'-0" (6.1 m) intervals.

D. Refer to Section 15190 for Mechanical Identification.

TABLE I  
SCHEDULE OF PIPING IDENTIFICATION

<u>CLASSIFICATION</u>	<u>BACKGROUND COLOR</u>	<u>LETTERING</u>
(Per ANSI A13.1)		
Domestic Cold Water	Green	White
Domestic Hotwater Supply	Green	White
Domestic Hotwater Return	Green	White
Equipment Drains, Roof Drains	Green	White
Sanitary Drains, Storm Drains	Green	White
Fire Protection Water	Red	White
Plumbing Vent Lines	Green	White
Compressed Air	Blue	White

3.9 FIRE-STOP MATERIALS

A. Seal around all pipes, ducts, and conduit penetrating fire-rated partitions, in accordance with manufacturer's instructions. Caulk and putty shall be applied to the proper depth for the fire rating required, as listed in the manufacturer's instructions.

END OF SECTION

## SECTION 15080

## THERMAL INSULATION FOR MECHANICAL SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1995a) Stainless and Steel Wire
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1992) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 871	(1995) Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

ASTM C 916	(1985; Rev 1996) Adhesives for Duct Thermal Insulation
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 921	(1989 R; 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C 1126	(1996) Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM D 3278	(1996) Test Methods for Flash Point of Liquids by Small Scale & Closed-Cup Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
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MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA-01	(1993) National Commercial & Industrial Insulation Standards
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## 1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

## 1.3 GENERAL QUALITY CONTROL

### 1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

### 1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Jackets shall comply with the flame

spread and smoke developed ratings of 25/50 as determined by ASTM E 84.

#### 1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-14 Samples

Thermal Insulation Materials; FIO.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

After approval of materials and prior to applying insulation a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA-01 plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment required to be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application.

The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label which identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

#### 1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

### PART 2 PRODUCTS

#### 2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet

ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

#### 2.1.1 Adhesives

##### 2.1.1.1 Acoustical Lining Insulation Adhesive

Insulation shall be applied in cut-to-size pieces attached to the interior of the duct with a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire-resistant adhesive to prevent delamination of glass fibers.

##### 2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

##### 2.1.1.3 Lagging Adhesive

Lagging adhesives shall be nonflammable and fire-resistant and shall have flame spread and smoke developed ratings of 25/50 when measured in accordance with ASTM E 84. Adhesives shall be either the Class 1 or Class 2 type as defined below. Class 1 adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation. Class 2 adhesive shall be pigmented white and be suitable for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

#### 2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent with a low flash point (flash point less than minus 25 degrees F when tested in accordance with ASTM D 3278) or, dispersed in a nonflammable organic solvent which shall not have a fire point below 200 degrees F. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The adhesive shall be nonflammable and fire resistant.

#### 2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

#### 2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

#### 2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449/C 449M.

#### 2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with

ASTM E 84. Fibrous glass cloth and tape shall be 20 x 20 maximum size mesh. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard.

#### 2.1.7 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

#### 2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pound/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pound/inchwidth. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.1 White Vapor Retarder ASJ (All Service Jacket)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.2 NOT USED

##### 2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch. Insulation under PVC jacket shall meet jacket manufacturer's written recommendations.

#### 2.1.9 Vapor Retarder Coating

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall not exceed 0.05 perm and shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. The flash point of the compound shall not be less than 80 degrees F and shall be determined in accordance with ASTM D 3278. All other application and service properties shall be in accordance with ASTM C 647.

##### 2.1.10 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

#### 2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be as follows:

##### 2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F shall be as follows:

###### 2.2.1.1 Cellular Glass

ASTM C 552, Type II, and Type III.

###### 2.2.1.2 Flexible Cellular Insulation

ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both

sides of the insulation.

#### 2.2.1.3 Phenolic Insulation

ASTM C 1126, Type III. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

#### 2.2.2 Aboveground Hot Pipeline

For aboveground hot pipeline above 60 degrees F insulation the following requirements shall be met.

##### 2.2.2.1 Mineral Fiber

ASTM C 547, Class 1 or Class 2 as required for the operating temperature range.

##### 2.2.2.2 Calcium Silicate

ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature.

##### 2.2.2.3 Cellular Glass

ASTM C 552, Type II and Type III.

##### 2.2.2.4 Flexible Cellular Insulation

ASTM C 534, Type I or II to 200 degrees F service.

##### 2.2.2.5 Phenolic Insulation

ASTM C 1126 Type III to 250 F service. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

#### 2.2.3 Below ground Pipeline Insulation

ASTM C 552, Type II.

#### 2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be as follows:

##### 2.3.1 Rigid Mineral Fiber

ASTM C 612, Class 1.

##### 2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-2.

##### 2.3.3 Cellular Glass

ASTM C 552, Type I.

##### 2.3.4 Phenolic Foam

ASTM C 1126 Type II. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

##### 2.3.5 Flexible Cellular

ASTM C 534 Type II.

### PART 3 EXECUTION

#### 3.1 APPLICATION - GENERAL

##### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until [tests] [tests and heat tracing] specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the drawings.

##### 3.1.2 Fire stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07270 FIRE STOPPING.

##### 3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTING, GENERAL.

##### 3.1.4 Flexible Cellular Insulation

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry.

##### 3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

##### 3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required, unless stated otherwise, on all pipes, ducts, or equipment, which operate at or below 60 F and at or above 80 F.

#### 3.2 PIPE INSULATION INSTALLATION

##### 3.2.1 Pipe Insulation

###### 3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a

single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Unions in pipe above 60 degrees F.
- e. Strainers in pipe above 60 degrees F.
- f. Check valves in pipe above 60 degrees F.
- g. Air chambers.

#### 3.2.1.2 Pipes Passing Through Sleeves

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.
- e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.
- f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.
- g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

#### 3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.
- b. Horizontal pipes larger than 2 inches at 60 degrees F and above

shall be supported on hangers in accordance with MSS SP-69, and Section 15400 PLUMBING, GENERAL PURPOSE.

- c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass or calcium silicate shall be installed above each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.
- d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.
- e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

#### 3.2.1.4 Pipes Passing Through Walls

- a. For hot water pipes supplying lavatories or other similar heated service which requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. Caulk the annular space between the pipe and wall penetration. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inch.
- b. For domestic cold water pipes requiring insulation, the insulation shall be terminated on the finished side of the wall (i.e.

insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Caulk the annular space between the pipe and wall penetration. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inch.

3.2.1.5 Flexible Cellular Pipe Insulation

Flexible cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere insulation directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.2 Aboveground Cold Pipelines

The following shall be included for aboveground cold pipelines minus 30 degrees to plus 60 degrees F:

- a. Domestic cold water.
- b. Make-up water.
- c. Refrigerant suction lines.
- d. Air conditioner condensate drains.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service	Material	Runouts up to 2 in*	1 in & less	1.25 - 2 in
Refrigerant suction piping	CG		1.5	1.5
	FC		1.0	1.0
	PF		1.0	1.0
Cold domestic water, above and below ceilings	CG	1.5	1.5	1.5
	FC	3/8	3/8	3/8
	PF	3/8	3/8	3/8
Exposed lavatory drains exposed domestic water piping & drains to areas for handicap personnel	FC	0.5	0.5	0.5
	MF	0.5	1.0	1.0
Air	FC		3/8	0.5

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service	Material	Runouts up to 2 in*	1 in & less	1.25 - 2 in
conditioning condensate drain located inside building	PF		3/8	3/8

\*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like main feed pipe.

LEGEND:

- PF - Phenolic Foam
- CG - Cellular Glass
- CS - Calcium Silicate
- MF - Mineral Fiber
- FC - Flexible Cellular

3.2.2.2 Jacket for Fibrous, Cellular Glass, and Phenolic Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket.

3.2.2.3 Insulation for Straight Runs (Fibrous, Cellular Glass and Phenolic Foam)

- a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor retarder coating at intervals not to exceed 15 feet.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating.
- f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating. The patch shall extend not less than 1-1/2 inches past the break.
- g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.

#### 3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall have ends thoroughly coated with a vapor retarder coating not less than 6 inches from each flange, union, valve, anchor, or fitting in all directions.
- b. Precut, preformed insulation for placement over fittings, flanges, unions, valves, anchors, and mechanical couplings shall be used. Precut, preformed insulation shall exhibit the same properties as the adjoining pipe insulation. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow.
- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.
- e. Flexible connections at pumps and other equipment shall be insulated with 0.59 inch flexible cellular insulation, unless otherwise indicated.
- f. Insulation shall be marked showing the location of unions, strainers, and check valves.

#### 3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same thickness as adjoining pipe insulation and the insulation shall be protected with one coat of vapor retarder coating under the PVC cover. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

#### 3.2.3 Aboveground Hot Pipelines

For hot pipelines above 60 degrees F the following shall be included:

- a. Domestic hot water.

##### 3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

#### LEGEND:

PF - Phenolic Foam

- CG - Cellular Glass
- CS - Calcium Silicate
- MF - Mineral Fiber
- FC - Flexible Cellular

Table II - Hot Piping Insulation Thickness  
Pipe Size (inches)

Type of Service (degrees F)	Material	Runouts up to 2 in	1 in & less	1.25 - 2 in
Hot domestic water supply & recirculating system (200 F max)	CG	1.5	1.5	1.5
	FC	0.5	1.0	1.0
	PF	0.5	1.0	1.0
	MF	0.5	1.0	1.0

\*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

3.2.3.2 Jacket for Insulated Pipe

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.
- f. Flexible cellular pipe insulation shall be installed by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 6 inches shall not be

stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

#### 3.2.3.4 Insulation for Fittings and Accessories

- a. The run of the line pipe insulation shall have the ends brought up to the item.
- b. Insulation of the same thickness and conductivity as the adjoining pipe insulation, either premolded or segmented, shall be placed around the item abutting the adjoining pipe insulation, or if nesting size insulation is used, overlapping 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3 inch size shall be premolded. Insulation for elbows 3 inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall have not less than 3 segments per elbow. Insulation may be wired or taped on until finish is applied.
- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of Class 1 adhesive applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16 inch.
- d. Insulation terminations shall be tapered to unions at a 45-degree angle.
- e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers.

#### 3.2.4 NOT USED

##### 3.2.4.1 NOT USED

##### 3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be used with PVC lagging and adhesive welded moisture tight.

##### 3.2.4.3 PVC Lagging

PVC lagging shall be ultraviolet resistant and adhesive welded vapor tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

#### 3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be

installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

### 3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III.

Table III - Minimum Duct Insulation (inches)

Cold and Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

### 3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder for cold air duct below 60 degrees F: Ducts and associated equipment shall be insulated to a thickness which is in accordance with Table III. The following shall be insulated:

- a. Supply ducts.
- b. Return air ducts.
- c. Relief ducts.
- d. Flexible runouts (field-insulated).
- e. Fresh air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I jacket; or, a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I all service jacket. Insulation for exposed ducts shall be provided with either a white, paintable, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Fibrous and cellular glass insulation on concealed duct shall be provided with a factory-applied Type I vapor retarder jacket. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any uninsulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation.

#### 3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.
- f. Jacket overlaps shall be secured under the overlap with Class 2 adhesive and stapled on 4 inch centers. Staples and seams shall be coated with a brush coat of vapor retarder coating.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

#### 3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.
- b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.
- d. Joints in the insulation jacket shall be sealed with a 4 inchwide strip of the same material as the vapor retarder jacket. The

strip shall be secured with Class 2 adhesive and stapled. Staples and seams shall be sealed with a brush coat of vapor retarder coating.

- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with Class 2 adhesive and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide stripe on 12 inch centers.

### 3.3.3 NOT USED

### 3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

### 3.3.5 NOT USED

### 3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

-- End of Section --

## SECTION 15400

## PLUMBING, GENERAL PURPOSE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22 (1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 74 (1996) Cast Iron Soil Pipe and Fittings

ASTM A 105/A 105M (1996) Carbon Steel Forgings for Piping Applications

ASTM A 193/A 193M (1997a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 515/A 515M (1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

ASTM A 516/A 516M (1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

ASTM A 888 (1996) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B 32 (1996) Solder Metal

ASTM B 88 (1996) Seamless Copper Water Tube

ASTM B 88M (1996) Seamless Copper Water Tube (Metric)

ASTM B 370 (1992) Copper Sheet and Strip for Building Construction

ASTM B 641 (1993) Seamless and Welded Copper Distribution Tube (Type D)

ASTM B 813 (1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C 564 (1995a) Rubber Gaskets for Cast Iron Soil

## Pipe and Fittings

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM D 2235	(1996a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3122	(1995) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1995) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1996a) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E 1	(1995) ASTM Thermometers
ASTM F 409	(1995) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1993a) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	(1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
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## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE ANSI/ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE ANSI/ASSE 1003	(1995) Water Pressure Reducing Valves for Domestic Water Supply Systems

ASSE 1005	(1986) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE ANSI/ASSE 1011	(1995) Hose Connection Vacuum Breakers
ASSE ANSI/ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE ANSI/ASSE 1037	(1986; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA ANSI/AWWA C105/A21.5	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

## CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(1995) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1995) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI HSN-85	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

## CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 430	Energy Conservation Program for Consumer Products
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## COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA-02 (1995) Copper Tube Handbook  
 COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1 (1992; Errata Jun 1993) Accessible and Usable Buildings and Facilities  
 FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCCHR-01 (1993) Manual of Cross-Connection Control  
 MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (1995) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1990) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends

MSS SP-72 (1992) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73 (1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-78 (1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-85 (1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

MSS SP-110 (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01 (1996) National Standard Plumbing Code  
 NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)  
 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 14 (1996) Plastics Piping Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1991) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 1508 (1996) Hose Clamps

UNDERWRITERS LABORATORIES (UL)

UL 174 (1996; Rev thru Nov 1997) Household Electric Storage Tank Water Heaters

## 1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

## 1.3 NOT USED

## 1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Vibration-Absorbing Features; GA.

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

SD-04 Drawings

Plumbing System; GA.

Detail drawings consisting of illustrations, schedules, performance charts,

instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics; GA.

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

#### SD-06 Instructions

Plumbing System; GA.

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

#### SD-09 Reports

Tests, Flushing and Disinfection ; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests; FIO.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

#### SD-13 Certificates

Materials and Equipment; GA.

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts; FIO.

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

## SD-19 Operation and Maintenance Manuals

Plumbing System; GA.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

## 1.6 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with NAPHCC-01.

## 1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II.

Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF ANSI/NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

## 2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- d. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.
- e. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

- f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.
- g. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- k. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- l. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- m. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- n. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- o. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.
- p. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.
- q. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

#### 2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J 1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:

AWWA C203.

- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Polyethylene Encasement for Ductile-Iron Piping: AWWA ANSI/AWWA C105/A21.5.
- l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.
- m. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ASSE ANSI/ASSE 1001
Water Pressure Reducing Valves	ASSE ANSI/ASSE 1003
Water Heater Drain Valves	ASSE 1005

Description	Standard
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22

#### 2.3.1 NOT USED

#### 2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

#### 2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

#### 2.3.4 NOT USED

#### 2.3.5 NOT USED

#### 2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.

Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face

plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

## 2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE ANSI/ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE ANSI/ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE ANSI/ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

## 2.6 DRAINS

### 2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.2 NOT USED

2.6.3 NOT USED

2.6.4 NOT USED

2.6.5 NOT USED

### 2.6.6 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded or caulked connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the

strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	36 square inches
Height of funnel	3-3/4 inches
Diameter of lower portion of funnel	2 inches
Diameter of upper portion of funnel	4 inches

2.7 NOT USED

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 NOT USED

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls with an adjustable range that includes 90 to 120 degrees F. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.10.1 Automatic Storage Type

Heaters shall be complete with control system, and shall have ASME rated combination pressure and temperature relief valve.

2.10.1.1 NOT USED

2.10.1.2 NOT USED

2.10.1.3 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 1.5 KW. The elements shall be wired so that only one element can operate at a time.

2.10.1.4 Point-of-use, Tankless, Electric Water Heater

Point-of-use electric water heater conforming to applicable requirements of UL 499. Manufacturer's standard construction without hot-water storage.

Electric heating system shall be manufacturer's standard electric-resistance type. Jacket shall be aluminum or steel with baked-on enamel finish. Provide bracket or device for wall mounting. Provide adjustable thermostat for temperature control. Provide automatic high-temperature-limit cutoff.

2.11 NOT USED

2.12 NOT USED

2.13 NOT USED

2.14 COMPRESSED AIR SYSTEM

2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 1 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensates before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated.

The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.14.2 Lubricated Compressors

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

2.14.3 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

#### 2.14.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

#### 2.14.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

#### 2.14.6 Pressure Regulators / Filter Combination

Regulator: Diaphragm type, air loaded, tight closing single seat, brass body.

Filter: 125 psig operating pressure and filter housing of brass or bronze. Provide cellulose cartridge filters of graded density construction capable of removing liquids and solids of 5 microns and larger. Filter capacity shall be compatible with rated flow of equipment or pressure reducing valves provided.

Both Regulator and Filter shall be attached to a common metallic bracket pre-drilled for wall mounting.

#### 2.15 LOW PRESSURE AIR DRYERS

Provide low pressure compressed air dryers of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger and a main compressed air cooling exchanger. Refrigeration system shall cool compressed air to dry the air. Dryer shall have no internal traps or filters and shall have pressure drop not greater than 3 psi. Air shall leave the dryer at a dew point of 38 degrees F, based on an inlet temperature of 100 degrees F. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary.

##### 2.15.1 Air Circuit

a. Regenerate Heat Exchanger: Inlet compressed air to outlet compressed air heat exchanger designed to reduce cooling load at design conditions minus 7 degrees C 20 degrees F inlet air precooling.

b. Main Heat Exchanger: Single-pass, with air in the tubes, heat sink, direct expansion, or flooded cooler type.

c. Separator: Fabricated in accordance with ASME B31.1; code stamp not required; moisture separator low velocity type incorporating change of air flow direction to prevent moisture carryover.

d. Dryer Operating Pressure: 125 psig working pressure.

e. Drain Line: Provide with exterior mounted condensate trap to facilitate servicing.

##### 2.15.2 Refrigeration System

- a. Refrigeration Compressor: ARI 520. Hermetic, semi-hermetic, or open reciprocating type equipped with automatic start-stop or unloading capacity control; standard components include inherent motor protection, crankcase oil strainer, and suction screen. Refrigerant shall be R-22.
- b. Dryer Controls: Capable of automatic 0 to 100 percent capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.
- c. Refrigerant dryer and suction line strainer.
- d. Air-cooled condenser, with condenser fan and motor.

### 2.15.3 Instrumentation and Control

Include control panel in the dryer cabinet containing:

- a. Indicators for the Following Services: Inlet air pressure gage, discharge air pressure gage, inlet air temperature gage, main exchanger temperature gage, refrigeration compressor suction pressure gage, refrigeration compressor discharge pressure gage, green "Power On" light, power interruption light, and high temperature light.
- b. Electrical Relays: Locate in an enclosed portion of the panel, accessible for ease of servicing.
- c. Controls and Interlocks: To maintain required compressed air dew point and to cycle air-cooled condenser with refrigeration compressor.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

#### 3.1.1 Water Pipe, Fittings, and Connections

##### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture,

except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

#### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

#### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

#### 3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

#### 3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided,

toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

#### 3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

#### 3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

##### 3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

##### 3.1.3.2 NOT USED

##### 3.1.3.3 Union and Flanged

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

##### 3.1.3.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

##### 3.1.3.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiframe torch.

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA-02 with flux and are acceptable for line sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing

filler metal.

- b. Soldered. Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA-02.
- c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

#### 3.1.3.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

#### 3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

#### 3.1.5 Corrosion Protection for Buried Pipe and Fittings

##### 3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA ANSI/AWWA C105/A21.5. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

##### 3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

#### 3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

##### 3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs

shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

#### 3.1.6.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be

installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

#### 3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

#### 3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

#### 3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

#### 3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

#### 3.1.8 Supports

##### 3.1.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of

the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 NOT USED

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
  - (1) Be used on insulated pipe less than 4 inches.
  - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
  - (3) Have a high density insert for pipe 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 8 pcf or greater.

1. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
  - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
  - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
  - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.
- o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

### 3.1.9 NOT USED

### 3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where

cleanouts are provided with adjustable heads, the heads shall be cast iron or plastic.

### 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

#### 3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

#### 3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.3 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

#### 3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

#### 3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor.

### 3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

### 3.3.4 NOT USED

### 3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

#### 3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

#### 3.3.5.2 Support for Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

#### 3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

#### 3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

#### 3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

### 3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC-01 at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed

at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

### 3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

### 3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

### 3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

## 3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 5 percent of the lowest equipment rpm.

### 3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

### 3.5 NOT USED

## 3.6 IDENTIFICATION SYSTEMS

### 3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

### 3.6.2 Color Coding

Color coding for piping identification shall be as specified in Section 09900 PAINTING, GENERAL.

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with NAPHCC-01.

- a. Drainage and Vent Systems Tests.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of
Gauges	

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 NOT USED

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of

screwed joints or holes will not be acceptable.

### 3.9.3 System Flushing

Before tests, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

### 3.9.4 Operational Test

Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

### 3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a

solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in proper disinfection containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.10 PLUMBING FIXTURE SCHEDULE

#### P-1 WATER CLOSET HANDICAPPED:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, wall hung.

Gasket shall be wax type.

Seat - ANSI Z124.5, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE ANSI/ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 1.6 gallons per flush. Height of top rim of bowl shall be in accordance with CABO A117.1.

#### P-1A WATER CLOSET TANK TYPE HANDICAPPED:

ASME A112.19.2M, close-coupled, white vitreous china, water conservation type, floor-mounted, floor outlet reverse trap, elongated bowl, white solid plastic elongated open-front seat with cover, and ASME A112.19.5 trim. Nonfloat swing type flush valves are not acceptable. Water flushing volume shall not exceed 1.6 gallons per flush.

#### P-3 URINAL:

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 1 gallon per flush.

#### P-2 WHEELCHAIR LAVATORY:

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 20 inches wide x 27 inches deep with gooseneck spout. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water

pressure of 80 psi. Lavatory suitable for countertop installation, self-rimming. Verify counter dimensions prior to submittals.

Drain - Strainer shall be copper alloy or stainless steel.

#### P-4 KITCHEN SINK:

Ledge back with holes for faucet and spout double bowl 32 x 21 inches stainless steel ASME A112.19.3M. Verify counter dimensions prior to submittals.

Faucet and Spout - Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

EEW-1 - Emergency Eye Wash: Head Emergency Eye and Face Wash. Shower control shall be 1 inch stay-open type control valve. Unit shall be corrosion-resisting steel and shall be floor mounted.

### 3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

### 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

#### 3.12.1 Storage Water Heaters

##### 3.12.1.1 Electric

- a. Storage capacity of 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

- b. Storage capacity of more than 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

3.13 TABLES

TABLE I  
PIPE AND FITTING MATERIALS FOR  
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE				
		A	B	C	D	E
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X	X	X	

SERVICE:

- A - Underground Building Soil, Waste and Storm Drain
- B - Aboveground Soil, Waste, Drain In Buildings
- C - Underground Vent
- D - Aboveground Vent
- E - Interior Rainwater Conductors Aboveground
- F - Corrosive Waste And Vent Above And Belowground
- \* - Hard Temper

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
1	Steel pipe: a. Seamless, black, ASTM A 53, Type S, Grade B	X	X	X X	X
2	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
3	Seamless and welded copper distribution tube (Type D) ASTM B 641	X**	X**	X**	X****
4	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 8 and 9	X	X	X	X

A - Cold Water Aboveground  
B - Hot Water 180 degrees F Maximum Aboveground  
C - Compressed Air Lubricated  
D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

\*\* - Type L - Hard

\*\*\* - Type K - Hard temper with brazed joints only or type K-soft temper  
without joints in or under floors

\*\*\*\* - In or under slab floors only brazed joints

TABLE III  
 STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING  
 EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	120 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum

TERMS:

- EF = Energy factor, overall efficiency.
- ET = Thermal efficiency with 70 degrees F delta T.
- EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).
- SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.
- HL = Heat loss of tank surface area
- V = Storage volume in gallons

-- End of Section --

## SECTION 15653

## AIR-CONDITIONING SYSTEM (UNITARY TYPE)

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI ANSI/ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 460	(1994) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI ANSI/ARI 710	(1986) Liquid-Line Driers
ARI ANSI/ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1994) Thermostatic Refrigerant Expansion Valves
ARI 760	(1994) Solenoid Valves for Use with Volatile Refrigerants

## AIR DIFFUSION COUNCIL (ADC)

ADC 1062:GRD	(1984) Test Codes for Grilles, Registers and Diffusers
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## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(1994) Test Methods for Louvers, Dampers and Shutters
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## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the Identification of Piping Systems
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 653/A 653M	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 280	(1995a) Seamless Copper Tube for Air Conditioning and Refrigeration Field

## Service

ASTM C 534 (1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM D 520 (1984; R 1995) Zinc Dust Pigment

ASTM D 3308 (1991a) PTFE Resin Skived Tape

ASTM E 437 (1992) Industrial Wire Cloth and Screens (Square Opening Series)

ASTM F 104 (1993) Nonmetallic Gasket Materials

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 (1994) Safety Code for Mechanical Refrigeration

ASHRAE 52.1 (1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1 (1995; B31.1a; B31.1b; B31.1c) Power Piping

ASME B31.5 (1992; B31.5a) Refrigeration Piping

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1 (1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX (1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

## AMERICAN WELDING SOCIETY (AWS)

AWS-01 (1991) Brazing Handbook

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

AWS D1.1 (1996) Structural Welding Code - Steel

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Industrial Control and Systems, Enclosures

NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators
NEMA MG 2	(1989) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1996; Errata 96-4) National Electrical Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems
NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)	
NAIMA AH115	(1993) Fibrous Glass Duct Construction Standards
SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)	
SMACNA-05	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA-06	(1995) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-10	(1985) HVAC Air Duct Leakage Test Manual
UNDERWRITERS LABORATORIES (UL)	
UL 181	(1996; Rev Oct 1996) Factory-Made Air Ducts and Air Connectors
UL 214	(1997) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1995) Fire Dampers
UL 586	(1996) High-Efficiency, Particulate, Air Filter Units
UL 900	(1994; Rev thru Apr 1997) Test Performance of Air Filter Units
UL 1995	(1995; Rev thru Feb 97) Heating and Cooling Equipment
UL Bld Mat Dir	(1997) Building Materials Directory
UL Elec Const Dir	(1997) Electrical Construction Equipment Directory
UL Fire Resist Dir	(1997) Fire Resistance Directory (2 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Air-Conditioning/Heat Pump System; FIO.

Manufacturer's standard catalog data, prior to the purchase or installation of a particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements. Data shall be submitted for each specified component. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

## SD-04 Drawings

Air-Conditioning/Heat Pump System; FIO.

Drawings shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

- (1) Equipment layouts which identify assembly and installation details.
- (2) Piping layouts which identify valves and fittings.
- (3) Plans and elevations which identify clearances required for maintenance and operation.
- (4) Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- (5) Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.
- (6) Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- (7) Automatic temperature control diagrams and control sequences.
- (8) Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

## SD-06 Instructions

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

## SD-07 Schedules

Tests; FIO.

A letter, at least 10 working days in advance of each tests, advising the Contracting Officer of the test. Individual letters shall be submitted for the condenser water system, refrigerant system, ductwork leak tests, cooling tower tests, condenser water quality tests, and the system performance tests. Each letter shall identify the date, time, and location for each test.

Demonstrations; GA.

A letter, at least 14 working days prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions; FIO.

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

#### SD-09 Reports

Tests; GA.

Six copies of each test containing the information described below in bound 8-1/2 x 11 inch booklets. Individual reports shall be submitted for the condenser water system, refrigerant system, ductwork leak tests, and the cooling tower tests.

- (1) The date the tests were performed.
- (2) A list of equipment used, with calibration certifications.
- (3) Initial test summaries.
- (4) Repairs/adjustments performed.
- (5) Final test results.

System Performance Tests; GA.

Six copies of the report shall be provided in bound 8-1/2 x 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

- (1) Date and outside weather conditions.
- (2) The load on the system based on the following:
  - (a) The refrigerant used in the system.
  - (b) Condensing temperature and pressure.
  - (c) Suction temperature and pressure.
  - (d) Ambient, condensing and coolant temperatures
  - (e) Running current, voltage and proper phase sequence for each phase of all motors.
- (3) The actual on-site setting of operating and safety controls.
- (4) Thermostatic expansion valve superheat - value as determined by field test

- (5) Subcooling
- (6) High and low refrigerant temperature switch set-points
- (7) Low oil pressure switch set-point
- (8) Defrost system timer and thermostat set-points
- (9) Moisture content
- (10) Capacity control set-points
- (11) Field data and adjustments which affect unit performance and energy consumption.
- (12) Field adjustments and settings which were not permanently marked as an integral part of a device.

#### SD-13 Certificates

##### Air-Conditioning/Heat Pump System.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

#### SD-19 Operation and Maintenance Manuals

##### Operation Manual; FIO.

Six complete copies of an operation manual in bound 8-1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

##### Maintenance Manual; FIO.

Six complete copies of maintenance manual in bound 8-1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

### 1.3 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the

tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of all material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

#### 1.5 PROJECT/SITE CONDITIONS

##### 1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

##### 1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Equipment, ductwork, and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

#### 2.2 NAMEPLATES

Major equipment including compressors, condensers, receivers, heat exchanges, fans, cooling towers, pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

#### 2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in

accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

## 2.4 MISCELLANEOUS MATERIALS

### 2.4.1 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

### 2.4.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

### 2.4.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

### 2.4.4 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

### 2.4.5 Pressure and Vacuum Gauge

Gauge shall conform to ASME B40.1, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

### 2.4.6 Temperature Gauges

Industrial duty thermometers shall be provided for the required temperature range. Thermometers shall have Fahrenheit scale in 2 degree graduations scale on a white face. The pointer shall be adjustable.

#### 2.4.6.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube.

#### 2.4.6.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

#### 2.4.6.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

#### 2.4.6.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

#### 2.4.7 Unicellular Plastic Foam

Unicellular plastic foam shall be in accordance with ASTM C 534, Form T, except that D-Factor shall not exceed 0.28 at 75 degrees F mean temperature.

#### 2.4.8 Bird Screen

Screen shall be in accordance with ASTM E 437, Type 1, Class 1, 2 by 2 mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

### 2.5 UNITARY EQUIPMENT, ROOM UNIT

#### 2.5.1 NOT USED

#### 2.5.2 Packaged Terminal Unit (PTAC-2.1)

Unit shall be a through-the-wall mounted, heavy-duty commercial grade, factory assembled and precharged heat pump unit. Unit shall be in accordance with ARI 310/380/CSA C744 and UL 1995. Units shall be removable from inside the building for servicing without removing the outside cabinet. Heat pump units shall contain a reversing valve to change unit to heating cycle. An outdoor coil temperature sensor shall be provided to guard against coil freeze-up by either switching to supplemental heat only, or by cycling the compressor to defrost the coil.

#### 2.5.3 Compressor

Compressor shall be hermetically sealed reciprocating, rotary, or scroll type. Compressor shall be fitted with permanent split capacitor motor, overload protection, and vibration isolators. Compressor shall be protected against high discharge pressure, loss of charge, low voltage, and short cycling.

#### 2.5.4 Air-To-Refrigerant Coils

Evaporator and condenser coils shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 3 mil thick phenolic or vinyl coating. Casing shall be galvanized steel or

aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. A condensate removal system shall be provided.

#### 2.5.5 Fans

Indoor and outdoor fans shall be the centrifugal, direct driven type. Fans shall be statically and dynamically balanced. Outdoor fan shall be designed so that condensate will evaporate without drip, splash, or spray on building exterior. Indoor fan shall be provided with a minimum two-speed motor with built-in overload protection. Fan motors shall be the inherently protected, permanent split-capacitor type.

#### 2.5.6 Air Filters

Filters shall be of the sectional or panel cleanable type and be capable of filtering the entire air supply.

#### 2.5.7 Primary/Supplemental Heat

Supplemental heat shall be provided as specified in paragraph "System Components".

#### 2.5.8 Cabinet Construction

Cabinet shall be free of visible fasteners, sharp protuberances and edges. Enclosure sheet metal shall be a minimum of 18 gauge steel with a protective coating. Face panels shall be removable and shall provide full access to unit appurtenances. Access to controls shall be without removal of the face panel. Conditioned air shall discharge through adjustable louvers. Cabinet shall be thermally and acoustically insulated with materials which conform to NFPA 90A. Units shall be furnished with a field-wired subbase. Subbase shall have leveling screws with provisions for remote unit control. Subbase shall be of 18 gauge galvanized steel construction with a protective coating to match that of the room cabinet. Paint and finishes shall comply with the requirements specified in paragraph "Factory Coating".

#### 2.5.9 Wall Sleeve

Louver shall be stormproof type, constructed of anodized, stamped or extruded aluminum. Sleeve shall be a water and airtight completely insulated assembly, with weather-resistant protective coating.

#### 2.5.10 Duct Package

Duct extension shall consist of 18 gauge minimum galvanized steel plenum extender with all necessary internal dampers and baffles to divert the supply air as indicated. Duct extension shall be painted with a protective coating that matches room cabinet.

#### 2.5.11 Unit Controls

Controls shall include an on-off switch, high and low selector switch for both the heating and cooling mode, multiple speed fan cooling and heating mode, room air fan switch, outside air damper control, and an adjustable cooling and heating thermostat. Function and temperature controls shall be remotely mounted as indicated.

#### 2.6 NOT USED

## 2.7 UNITARY EQUIPMENT, SPLIT SYSTEM (AC-3.1 and HP-3.1)

Unit shall be an air-cooled, split system which employs a remote condensing unit, a separate indoor unit, and interconnecting refrigerant piping. Unit shall be the heat pump type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with ARI ANSI/ARI 210/240. Unit shall be provided with necessary fans, air filters, coil frost protection, internal dampers, mixing boxes, supplemental heat, and cabinet construction as specified in paragraph "System Components". The remote unit shall be as specified in paragraph REMOTE CONDENSER OR CONDENSING UNIT. Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Condenser or outdoor fans shall be the manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors shall have totally enclosed enclosures.

### 2.7.1 Air-to-Refrigerant Coil

Coils shall have nonferrous tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 3 mil thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge.

Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

### 2.7.2 NOT USED

### 2.7.3 Refrigeration Circuit

Refrigerant-containing components shall comply with ASHRAE 15 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type. Refrigerant flow control devices shall be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve.

### 2.7.4 Unit Controls

Unit shall be internally prewired with a 24 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure, and safety interlocks on all service panels. Head pressure controls shall sustain unit operation with ambient temperature of 0 degrees F. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995.

### 2.8 NOT USED

### 2.9 NOT USED

### 2.10 REMOTE CONDENSING UNIT (HP-3.1)

Each remote condenser coil shall be fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing

temperature shall not exceed 120 degrees F at 95 degrees F ambient. Unit shall be provided with low ambient condenser controls to ensure proper operation in an ambient temperature of 0 degrees F as well as a short cycle compressor relay. Fan and cabinet construction shall be provided as specified in paragraph "System Components". Fan and condenser motors shall have totally enclosed enclosures.

#### 2.10.1 Air-Cooled Condenser

Unit shall be rated in accordance with ARI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

##### 2.10.1.1 Connections

Interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit shall be provided as required and as indicated. Electrical and refrigeration piping terminal connections between heat pump condensing unit and evaporator units shall be provided.

##### 2.10.1.2 Head Pressure Control and Liquid Subcooling

Low ambient control using condenser fan motor speed modulation shall provide condenser pressure controls for the refrigerant circuit. Controls shall be set to produce a minimum of 95 degrees F saturated refrigerant condensing temperature. Unit shall be provided with a liquid subcooling circuit which shall ensure proper liquid refrigerant flow to the expansion device over the specified application range of the condenser. Unit shall be provide with manufacturer's standard liquid subcooling. Subcooling circuit shall be liquid sealed.

##### 2.10.1.3 Condensing Coil

Coils shall have nonferrous tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 3 mil thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

##### 2.10.1.4 Unit Controls

The control system shall be complete with required accessories for regulating condenser pressure by fan cycling, solid-state variable fan speed, modulating condenser coil or fan dampers, flooding the condenser, or a combination of the above. Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include control transformer, fan motor starters, time delay start-up, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

##### 2.10.2 NOT USED

##### 2.10.3 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating,

or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Units 120,000 Btuh and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

2.11 NOT USED

2.12 SYSTEM COMPONENTS

2.12.1 NOT USED

2.12.2 NOT USED

2.12.3 Supplemental Heating (AC-3.1)

2.12.3.1 NOT USED

2.12.3.2 NOT USED

2.12.3.3 Electric Heating Coil

Coil shall be an electric duct heater in accordance with UL 1995 and NFPA 70.

Coil shall be duct- or unit-mounted. Coil shall be of the nickel chromium resistor, two stage, strip type. Coil shall be provided with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Coil casing and support brackets shall be of galvanized steel or aluminum. Coil shall be mounted to eliminate noise from expansion and contraction and be completely accessible for service.

2.12.4 Air Filters

Air filters shall be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test Method shall be as listed under the label service and shall meet the requirements of UL 586.

2.12.4.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth sectional type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested in accordance with ASHRAE 52.1. Initial resistance at 500 feet per minute will not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. Four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.12.5 Coil Frost Protection

Each circuit shall be provided with a coil frost protection system which is a manufacturer's standard. The coil frost protection system shall use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Timers shall be used to prevent the compressor from rapid cycling.

2.13 NOT USED

2.14 NOT USED

2.15 NOT USED

2.16 NOT USED

2.17 NOT USED

2.18 NOT USED

2.19 NOT USED

2.20 NOT USED

2.21 NOT USED

2.22 NOT USED

2.23 TEMPERATURE CONTROLS

Temperature controls shall be in accordance with Section 15950 HEATING, VENTILATING AND AIR OCNDITIONING HVAC CONTROL SYSTEMS.

2.24 DUCTWORK COMPONENTS

2.24.1 Metal Ductwork

All ductwork shall be galvanized with G90 coating. Every aspect of metal ductwork construction, including fittings and components, shall comply with SMACNA-06 unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. Class 3 through 10 inch shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA-06. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable.

2.24.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.24.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or

negative working pressure of 15 inches water gauge at 350 degrees F when duct is aluminum, and 650 degrees F when duct is galvanized steel or stainless steel.

#### 2.24.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runouts shall not exceed 10 feet in length, shall be preinsulated, factory fabricated, and comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulation material surface shall not be exposed to the air stream.

#### 2.24.1.4 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

#### 2.24.2 NOT USED

#### 2.24.3 Ductwork Insulation

Ductwork insulation and related materials shall conform to the requirements of Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.24.4 Ductwork Accessories

##### 2.24.4.1 Duct Access Doors

Access doors shall be provided in ductwork where indicated and at all air flow measuring devices, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA-06. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 x 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 x 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

##### 2.24.4.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the

assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA-05 and in manufacturer's instructions for fire dampers shall be followed.

#### 2.24.4.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing.

Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

#### 2.24.4.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at all duct mounted supply outlets, at all takeoff or extension collars to supply outlets, at all duct branch takeoff connections, and at all 90 degree elbows, as well as at all locations as indicated on the drawings or shown in the Sheet Metal and Air Contractors National Association manuals. Air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein before. Fixed air deflectors, also called turning vanes, shall be provided in all 90 degree elbows. Turning vanes shall be designed as shown in the Sheet Metal and Air Condition Contractors National Association manuals.

#### 2.24.5 Duct Sleeves, Framed Prepared Openings, Closure Collars

##### 2.24.5.1 Duct Sleeves

Duct sleeves shall be provided for all round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and all square, rectangular, and oval ducts passing

through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

#### 2.24.5.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

#### 2.24.5.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and all square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

#### 2.24.6 NOT USED

#### 2.24.7 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified in accordance with ADC 1062:GRD. Inlets and outlets shall be sound rated and certified in accordance with ADC 1062:GRD. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers.

##### 2.24.7.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with antismudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

#### 2.24.7.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

#### 2.24.8 Louvers

Louvers shall be furnished for installation in exterior walls which are directly connected by ductwork to air handling equipment. Louver blades shall be fabricated from anodized aluminum or galvanized steel sheets, and shall be provided with a frame of galvanized steel or aluminum structural shapes. Sheet metal thickness and fabrication shall conform to SMACNA-06. Blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Louver shall be provided with bird screen. Louvers shall bear AMCA Certified Ratings Seal for air performance and water penetration ratings as described in AMCA 500.

#### 2.25 NOT USED

#### 2.26 REFRIGERANT PIPING

Refrigerant piping, valves, fittings, and accessories shall conform to the requirements of ASHRAE 15 and ASME B31.5, except as specified.

##### 2.26.1 NOT USED

##### 2.26.2 NOT USED

##### 2.26.3 NOT USED

##### 2.26.4 NOT USED

##### 2.26.5 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inch and smaller may be flared.

##### 2.26.6 Joints and Fittings, Copper Tubing

Copper tube joints and fittings shall be flare joint type with short-shank flare, or solder-joint pressure type. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints.

##### 2.26.7 Valves

Valves shall be pressure and temperature rated for contained refrigerant service and shall comply with ASME B31.5. Metals of construction shall be ferrous or copper based. Atmosphere exposed valve stems shall be stainless steel or corrosion resistant metal plated carbon steel. Valve body connections shall be brazed or welded socket, flanged or combination thereof. Threaded connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges

cannot be used. Valves shall be suitable for or fitted with extended copper ends for brazing in-place without disassembly. Ferrous body valves shall be fitted with factory fabricated and brazed copper transitions. To minimize system pressure drops, where practicable, globe valves shall be angle body type, and straight line valves shall be full port ball type. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by manufacturer. Valves shall be cleaned and sealed moisture-tight.

#### 2.26.7.1 Refrigerant-Stop Valves

Valves, in sizes through 5/8 inch, shall be handwheel operated, straight or angle, packless diaphragm globe type with back-seating stem, brazed ends, except where SAE flare or retained seal cap connections are required.

In sizes over 5/8 inch, valves shall be globe or angle type, wrench operated with ground-finish stems, or ball valves, packed especially for refrigerant service, back seated, and provided with seal caps. Refrigerant isolation and shut-off valves shall have retained or captive spindles and facilities for tightening or replacement of the gland packing under line pressure as applicable. Stop valves shall have back-seating plated steel stem, bolted bonnet in sizes 1-1/8 inches OD and larger, integral or flanged transition brazed socket. Valves in sizes through 2-1/2 inches shall be end-entry body assembly, full-port, floating ball type, with equalizing orifice fitted chrome plated ball, seats and seals of tetrafluoroethylene, chrome plated or stainless steel stem, and seal cap. In sizes 4 inch IPS and larger, and in smaller sizes where carbon steel piping is used, valve bodies shall be tongue and groove flanged and complete with mating flange, gaskets and bolting for socket or butt-weld connection. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

#### 2.26.7.2 Check Valves

Valve shall be designed for service application, spring-loaded type where required, with resilient seat and with flanged body in sizes 1/2 inch and larger. Valve shall provide positive shut-off at 1-1/2 psi differential pressure.

#### 2.26.7.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

#### 2.26.7.4 Expansion Valves

Expansion valves conform to requirements of ARI 750. Valve shall be of the diaphragm and spring type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator

pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads.

#### 2.26.7.5 Safety Relief Valve

Valve shall be the two-way type. Single type valves shall be used only where indicated. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

#### 2.26.7.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring power assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

#### 2.26.7.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with ARI ANSI/ARI 720.

#### 2.26.8 Accessories

##### 2.26.8.1 Filter Driers

Driers shall conform to ARI ANSI/ARI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psi.

##### 2.26.8.2 Sight Glass and Liquid Level Indicator

- a. Assembly and Components: Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.
- b. Gauge Glass: Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.
- c. Bull's-Eye and Inline Sight Glass Reflex Lens: Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighting viewing shall be provided.
- d. Moisture Indicator: Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be

furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

#### 2.26.8.3 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

#### 2.26.8.4 NOT USED

#### 2.26.8.5 NOT USED

#### 2.26.8.6 Brazing Materials

Brazing materials for refrigerant piping shall be in accordance with AWS A5.8, Classification BCuP-5.

### 2.27 DRAIN AND MISCELLANEOUS PIPING

Piping, fittings, valves and accessories for drain and miscellaneous services shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

### 2.28 FABRICATION

#### 2.28.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B 117 using a 25 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

#### 2.28.2 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

#### 3.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of

machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

### 3.1.2 Mechanical Room Ventilation

Mechanical rooms containing refrigeration components or equipment shall be ventilated to the outdoors as indicated. Refrigerant relief device vent piping which is not returned to the system shall be routed to the atmosphere as indicated. Relief piping shall be supported independently of relief device and braced against reaction forces. The ventilation system shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

### 3.1.3 Building Surface Penetrations

Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

#### 3.1.3.1 NOT USED

#### 3.1.3.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07900 JOINT SEALING.

#### 3.1.3.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17-ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

- a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.
- b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal. Rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

#### 3.1.3.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07840 FIRESTOPPING.

#### 3.1.3.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

#### 3.1.4 Access Panels

Access panels shall be provided for all concealed valves vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METALS.

#### 3.1.5 General Piping Installation

##### 3.1.5.1 Brazed Joints

Brazing shall be performed in accordance with AWS-01, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

### 3.1.5.2 Threaded Joints

Threaded joints shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

### 3.1.5.3 Welded Joints

Welded joints in steel refrigerant piping shall be fusion-welded. Changes in direction of piping shall be made with welded fittings only; mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. Branch connections shall be made with welding tees or forged welding branch outlets. Steel pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

### 3.1.5.4 Flanged Joints

Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for use with the refrigerants to be handled. When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, refrigeration equipment, control valves, and other similar items.

### 3.1.5.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

### 3.1.6 NOT USED

### 3.1.7 Refrigeration Piping

Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.5. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made.

#### 3.1.7.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

#### 3.1.7.2 Functional Requirements

Piping shall be installed 1/2 inch per 10 feet of pipe in the direction of

flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings.

#### 3.1.7.3 Manual Valves

Stop valves shall be installed on each side of each piece of equipment such as compressors, condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Angle and globe valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

#### 3.1.7.4 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

#### 3.1.7.5 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

#### 3.1.7.6 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

#### 3.1.7.7 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices and where indicated. Strainers may be an integral part of the expansion valve.

#### 3.1.7.8 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturers recommendations. A dryer shall be installed such that it can be isolated from the system,

the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

#### 3.1.7.9 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of filter dryers and where indicated. Sight glass shall be full line size.

#### 3.1.7.10 Flexible Connectors

Flexible metallic connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

#### 3.1.8 Thermometers

Thermometers located within 5 feet of floor may be rigid stem type. Where thermal well is located above 5 feet above floor, thermometer shall be universal adjustable angle type or remote element type to 7 feet above floor and remote element type where thermal well is 7 feet or more above floor. Thermometers shall be located in coolant supply and return or waste lines at each heat exchanger, condenser water lines entering and leaving the condenser, at each automatic temperature control device without an integral thermometer, refrigerant liquid line leaving receiver, refrigerant suction line at each evaporator or liquid cooler, and where indicated or required for proper operation of equipment.

#### 3.1.9 Piping Supports

Refrigerant pipe supports shall be in accordance with ASME B31.5. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

##### 3.1.9.1 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05210 STRUCTURAL STEEL.

##### 3.1.9.2 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Material used for support shall be as specified under Section 05210 STRUCTURAL STEEL.

##### 3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be

used.

3.1.11 NOT USED

3.1.12 NOT USED

3.1.13 NOT USED

3.1.14 Piping Identification

Each piping system and direction of fluid flow shall be identified in accordance with applicable provisions of ANSI A13.1 with color coded, water, moisture and broad-spectrum temperature resistant, plastic labels.

3.1.15 Metal Ductwork

Installation shall be in accordance with SMACNA-06 unless otherwise indicated. Duct supports for sheet metal ductwork shall be in accordance with SMACNA-06, unless otherwise specified. Friction beam clamps indicated in SMACNA-06 will not be used. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.16 NOT USED

Installation shall be in accordance with the manufacturer's written recommendations unless otherwise required in NAIMA AH115. Duct supports for fibrous glass ductwork shall conform to NAIMA AH115. In those cases not covered in NAIMA AH115, the written recommendation of the fibrous duct manufacturer shall be followed.

3.1.17 NOT USED

3.1.18 Field Applied Insulation

Field applied insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.19 NOT USED

3.1.20 Framed Instructions

Framed instructions shall be framed under glass or laminated plastic and be posted where directed. Instructions shall include equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The instructions shall be posted before acceptance testing of the system.

3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Utilities for testing shall be provided as specified in the SPECIAL CONTRACT REQUIREMENTS. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be

coordinated with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

### 3.2.1 NOT USED

### 3.2.2 Refrigerant System

After all components of the refrigerant system have been installed and connected, the entire refrigeration system shall be subjected to a pneumatic test as described herein.

#### 3.2.2.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

#### 3.2.2.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

#### 3.2.2.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

#### 3.2.2.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures.

Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

#### 3.2.2.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

#### 3.2.2.6 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim.

At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

#### 3.2.3 Ductwork Leak Tests

Ductwork leak test shall be performed for the entire air distribution system, including fans, coils, filters, etc. Test procedure, apparatus, and report shall conform to SMACNA-10. The maximum allowable leakage rate is 200 CFM. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

#### 3.3 NOT USED

#### 3.4 CLEANING AND ADJUSTING

##### 3.4.1 NOT USED

##### 3.4.2 Ductwork

Prior to testing, inside of ducts, plenums, and casing shall be thoroughly cleaned of all debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Temporary filters shall be provided for fans that are operated during construction. New filters shall be installed after all construction dirt has been removed from the building and the ducts, plenum, casings, and other items specified have been vacuum cleaned. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

##### 3.4.3 Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring

adjustment shall be adjusted to setting indicated or directed.

#### 3.4.4 Testing, Adjusting, and Balancing

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

#### 3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 2 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

## SECTION 15835

## TERMINAL HEAT TRANSFER UNITS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Electric unit heaters.

## 1.2 PRODUCTS FURNISHED AND INSTALLED UNDER OTHER SECTIONS

- A. Section 15950 - Heating, Ventilating and Air Conditioning HVAC Control Systems: Installation of room thermostats.

## 1.3 RELATED SECTIONS

- A. Section 15950 - Heating, Ventilating and Air Conditioning HVAC Control Systems.
- B. Section 16180 - Equipment Wiring Systems: Electrical supply to units.

1.4 CODES AND STANDARDS  
(Latest Edition or Revision)

- A. NFPA 70 - National Electrical Code.
- B. ARI 440 - Room Fan Coil Air Conditioners.
- C. UL 883 - Safety Standards for Fan Coil Units and Room Fan Heater Units.

## 1.5 SUBMITTALS: Submit shop drawings under provisions of Section 01300.

- A. SD-04 Shop Drawings

Terminal Heat Transfer Units; GA.

Submit shop drawings indicating cross section of cabinets, grille, bracing and reinforcing, and typical elevation.

- B. SD-01 Product Data

Terminal Heat Transfer Units; GA.

Submit product data indicating typical catalog of information including arrangements.

Installation Instructions: Terminal Heat Transfer Units; GA.

- C. Schedules: Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

- D. Service Location: Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.

- E. Installation Instructions: Submit manufacturer's installation instructions under provisions of Section 01300.

## 1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 01700.

- B. Accurately record actual locations of access doors in radiation cabinets required for access or valving.

## 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01700.
- B. Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

## 1.9 REGULATORY REQUIREMENTS

- A. Conform to applicable code for internal wiring of factory wired equipment.

## 1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Division 1.
- B. Store and protect products under provisions of Division 1.
- C. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

## 1.11 SEQUENCING AND SCHEDULING

- A. Sequence work under the provisions of Division 1.
- B. Schedule work under the provisions of Division 1.
- C. Install radiation, convectors, fan-coil units, unit ventilators and radiant heaters (equipment exposed to finished areas) after walls and ceiling are finished and painted. Avoid damage.

## 1.12 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Division 1.
- B. Warranty: Include coverage of unit heater motors.

## PART 2 PRODUCTS

## 2.1 ELECTRIC UNIT HEATERS - EXPLOSION-PROOF

- A. Contractors shall supply and install Markel type HLA explosion-proof suspended fan-forced unit heaters of the capacity and voltage listed on the plans. Heaters shall be UL listed for Class 1, Group D, Divisions 1 & 2 and Class II, Groups E, F, and G, Divisions 1 & 2, UL temperature code shall be T3B (165°C) for Class 1, and T3B (165°C) for Class II, indicating maximum operating surface temperatures.
- B. Heat exchangers shall be heavy walled, liquid filled, with three, low watt density, immersion type copper sheathed elements hermetically sealed into the core along with the high limit thermal cut-out. Heat transfer fluid shall be ethylene-glycol solution, protected to -45°C (-49°F).
- C. Motors shall be PSC, explosion-proof, permanently lubricated, ball bearing type, 1725 rpm.
- D. Contactors shall be built-in and pre-wired into an explosion-proof enclosure. Contactors shall be heavy-duty and break all ungrounded conductors and be rated for 100,000 cycles at full load. Control transformers shall be built-in and pre-wired. Control circuits shall be

24 volt.

- E. Cabinet shall be 14 gauge cold rolled steel, epoxy coated plated fan guard shall have less than 1/4 inch spacing to conform with OSHA requirements. All fasteners shall be zinc plated. Heater conduits shall be cadmium plated seamless steel or aluminum.

## 2.2 ACCEPTABLE MANUFACTURERS - ELECTRIC UNIT HEATERS

- A. Markel Products Co., Models are as listed below.

EUH 1.1 M# HLA12-208360-7.5-24  
Explosion-Proof Suspended horizontal

EUH 1.2 M# HLA12-208360-7.5-24  
Explosion-Proof Suspended horizontal

EUH 1.3 M# HLA12-208360-7.5-24  
Explosion-Proof Suspended horizontal

EUH 1.4 M# F3452-T  
Wall-Hung Surface Mount

EUH 2.1 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.2 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.3 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.4 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.5 M# F3452-T  
Wall-Hung Surface Mount

EUH 2.6 M# 3311TS-RP  
Architectural Recessed

EUH 3.1 M# F3452-T  
Wall-Hung Surface Mount

EUH 4.1 CAT # F2F5110CA1L  
Suspended Horizontal

Refer to the drawings for additional descriptions and requirements.

## 2.3 ELECTRIC UNIT HEATERS - STANDARD TYPE, NON-EXPLOSION-PROOF

- A. Assembly: UL listed and labelled assembly with terminal box and cover, and controls as indicated.
- B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
- C. Cabinet: 18 gage (1.3 mm) steel with easily removed front panel with integral air outlet and inlet grilles.
- D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

- F. Motor: Horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- G. Control: Separate fan speed switch and thermostat (where indicated) heat selector switch, factory wired, with switches built-in behind cover. Provide thermal overload.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and opening dimensions are as instructed by the manufacturer.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Beginning of installation means installer accepts existing surfaces.

#### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- C. Protect units with protective covers during balance of construction.
- D. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 sections.

#### 3.3 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION

## SECTION 15895

## AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline D (1987) Application and Installation of Central Station Air-Handling Units

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA ANSI/AMCA 210 (1985) Laboratory Methods of Testing Fans for Rating

AMCA 300 (1996) Reverberant Room Method for Sound Testing of Fans

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA Std 9 (1990) Load Ratings and Fatigue Life for Ball Bearings

ABEMA Std 11 (1990) Load Ratings and Fatigue Life for Roller Bearings

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993; Rev 1; Rev 2; Rev 3) Motors and Generators

## SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-10 (1985) HVAC Air Duct Leakage Test Manual

## 1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

## 1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Components and Equipment Data; FIO.

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Piping Components
- b. Ductwork Components
- c. Air Systems Equipment
- d. Air Handling Units
- e. Energy Recovery Devices
- f. Terminal Units

## SD-04 Drawings

Air Supply, Distribution, Ventilation, and Exhaust Equipment; FIO.

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

## SD-06 Instructions

Test Procedures; FIO.

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures; FIO.

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; GA.

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

## SD-07 Schedules

Test Schedules; FIO.

Proposed test schedules for hydrostatic test of piping, ductwork leak test,

and performance tests, at least 2 weeks prior to the start of related testing.

Field Training Schedule; FIO.

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

#### SD-08 Statements

Similar Services; FIO.

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welding Qualification; FIO.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

#### SD-09 Reports

Test Reports; FIO.

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

#### SD-13 Certificates

Bolts; FIO.

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

#### SD-19 Operation and Maintenance Manuals

Air Supply, Distribution, Ventilation, and Exhaust Manuals; FIO.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is

offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

## 2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

## 2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

## 2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

## 2.5 NOT USED

## 2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 10 hp or less. Adjustable frequency drives shall be used for larger motors.

## 2.7 CONTROLS

Controls shall be provided as specified in Section 15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS.

## 2.8 DUCTWORK COMPONENTS

Refer to Section 15653 AIR CONDITIONING SYSTEM (UNITARY TYPE).

## 2.9 AIR SYSTEMS EQUIPMENT

### 2.9.1 Fans

Fans shall be tested and rated according to AMCA ANSI/AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch

sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts.

Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 NOT USED

2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing.

Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA Std 9 and ABEMA Std 11. Motors shall have open or explosion-proof enclosure.

2.9.1.3 NOT USED

2.9.1.4 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 24 inches diameter shall be direct or V-belt driven and fans with wheels 24 inches diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof or explosion-proof type. Gravity or motor operated backdraft dampers shall be provided where indicated.

2.9.1.5 NOT USED

2.9.1.6 NOT USED

2.9.1.7 NOT USED

2.9.1.8 NOT USED

2.9.1.9 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

## PART 3 EXECUTION

## 3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

## 3.2 NOT USED

## 3.3 NOT USED

## 3.4 DUCTWORK LEAK TEST

Ductwork leak test shall be performed for the entire air distribution and exhaust system, including fans, and coils. Test procedure, apparatus, and report shall conform to SMACNA-10. The maximum allowable leakage rate is 5% of design airflow. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

## 3.5 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of fans, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

## 3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

## 3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 1 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient

temperature and humidity in a shaded and weather protected area.

### 3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

## SECTION 15950

## HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500 (1994) Test Methods for Louvers, Dampers and Shutters

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 88 (1996) Seamless Copper Water Tube

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1 (1995; Addenda Dec 1995, Dec 1996, Dec 1997) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

## ISA (ISA)

ISA S7.0.01 (1975; R 1981) Quality Standard for Instrument Air

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

## UNDERWRITERS LABORATORIES (UL)

UL 268A (1993; Rev thru May 1997) Smoke Detectors for Duct Application

UL 508 (1993; Rev thru Oct 1997) Industrial Control Equipment

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 1.2.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Equipment Compliance Booklet; FIO.

An HVAC control system equipment compliance booklet (ECB) in indexed booklet form with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a bill of materials for each HVAC control system. The bill of materials shall function as the table of contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB.

##### SD-04 Drawings

HVAC Control System; FIO.

Drawings on A1 34 by 22 inch sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and device identifiers shown. Each control-system element on a drawing shall have a unique identifier as shown. All HVAC control system drawings shall be delivered together as a complete submittal. Drawings shall be submitted for each HVAC system.

##### a. HVAC control system drawings shall include the following:

Sheet One: Drawing index, HVAC control system legend.

Sheet Two: Valve schedule, damper schedule.

Sheet Three: Compressed air station schematic.

Sheet Four: HVAC control system schematic and equipment schedule.

Sheet Five: HVAC control system sequence of operation and ladder diagram.

Sheet Six: HVAC control panel arrangement, control panel cross-section, and control panel inner door layout.

Sheet Seven: HVAC control panel back-panel layout.

Sheet Eight: Control loop wiring diagrams.

Sheet Nine: Motor starter and relay wiring diagram, including all additions and changes to starters specified in Division 16.

Note: Repeat sheets four through nine for each AHU system.

- b. An HVAC control system drawing index showing the name and number of the building, military site, State or other similar designation, and Country. The drawing index shall list all HVAC control system drawings, including the drawing number, sheet number, drawing title, and computer filename when used.
- c. An HVAC control system legend showing generic symbols and the name of devices shown on the HVAC control system drawings.
- d. A valve schedule showing each valve's unique identifier, size, flow coefficient (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data.
- e. A damper schedule showing each damper and actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The damper schedule shall include the maximum leakage rate at the operating static-pressure differential. The damper schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements.
- f. A compressed-air station schematic diagram showing all equipment, including: compressor with motor horsepower and voltage; starter; isolators; manual bypasses; tubing sizes; drain piping and drain traps; reducing valves; dryer; and data on manufacturer's names and model numbers, mounting, access, and clearance requirements. Air compressor and air dryer data shall include calculations of the air consumption of current-to-pneumatic transducers and any other control system devices to be connected to the compressed air station, and the compressed air supply dewpoint temperature at 20 psig.
- g. An HVAC control system equipment schedule showing the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e. output range).
- h. An HVAC control system sequence of operation.
- I. An HVAC control system ladder diagram showing all relays, contacts, pilot lights, switches, fuses and starters connected to the control system.
- j. HVAC control panel arrangement drawings showing both side and front views of the panel. The drawing shall show panel and mounting dimensions.
- k. HVAC control panel cross-section drawings showing mounting rails and standoffs for devices.
- l. HVAC control panel inner door layout drawings showing both front

and rear views of the inner door. The drawings shall show device locations, labels, nameplate legends, and fabrication details.

- m. HVAC control panel back-panel layout drawings showing device locations, labels, nameplate legends, terminal block layout, fabrication details, and enclosure operating temperature-rise calculations.
- n. HVAC control system wiring diagrams showing functional wiring diagrams of the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show all necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged-equipment control systems shall be identified back to the panel-board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown.

#### SD-08 Statements

##### Commissioning Procedures; FIO .

- a. Six copies of the HVAC control system commissioning procedures, in indexed booklet form, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal-unit control system. The commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.
- b. Commissioning procedures documenting detailed, product-specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product-specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.
- c. Commissioning procedures documenting controller configuration checksheets for each controller listing all configuration parameters, dip switch and jumper settings, and initial recommended P, I and D values. The configuration parameters shall be listed in the order in which they appear during the configuration process. Each configuration parameter shall be noted as being: set per specs with no field adjustment required, set per specs but field adjustable, or not applicable.
- d. Commissioning procedures showing a time clock configuration checksheet listing all parameters, and switch settings. The parameters shall be listed in the order which they appear during the setup process.
- e. An HVAC control system commissioning procedures equipment list that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

##### Performance Verification Test Procedures; FIO.

Six copies of the HVAC control system performance verification test procedures, in indexed booklet form, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Training Course Materials; FIO.

Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course. An HVAC control system training course, in outline form, with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training.

#### SD-09 Reports

Commissioning Report; FIO.

Six copies of the HVAC control system commissioning report, in indexed booklet form, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning and shall follow the format of the commissioning procedures. The commissioning report shall include all controller and time clock checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, and results of adjustments.

Performance Verification Test Report; FIO.

Six copies of the HVAC control system performance verification test report, in indexed booklet form, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

#### SD-13 Certificates

ASME Air-Storage Tank Certificate; FIO.

An ASME Air-Storage Tank Certificate for each storage tank.

#### SD-18 Records

Service Organizations; FIO.

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

#### SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Maintenance and Repair Manual; FIO.

Six copies of the HVAC control system operation manual for each HVAC control system 30 days before the date scheduled for the training course.

#### 1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

#### 1.5 OPERATION MANUAL

An HVAC control system operation manual for each HVAC control system, in indexed booklet form, shall be provided. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built controller configuration checksheets, the as-built time clock configuration checksheet, the HVAC control system front panel description, the procedures for changing HVAC system controller setpoints, the procedures for gaining manual control of processes, the time clock manufacturer's manual control of processes, the time clock manufacturer's operation manual, and the controller manufacturer's operation manual.

- a. The HVAC control system front panel description shall explain the meaning and use of the lights, switches, gauges, and controller displays located in the front panel. Each light, switch, gauge, and display described shall be numbered and referenced to a drawing of the front panel.
- b. The procedures for changing HVAC system controller setpoints shall describe the step-by-step procedures required to change: the process variable setpoints of controllers, the alarm setpoints of controllers, the controller bias settings, and controller setpoint reset schedules.
- c. The procedures for gaining manual control of processes shall describe step-by-step procedures required to gain manual control of devices and manually adjust their positions.

## PART 2 PRODUCTS

### 2.1 MATERIAL AND EQUIPMENT

Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. The Contractor shall submit a certified list of qualified permanent service organizations and qualifications. These service organizations shall be reasonably convenient to the equipment on a regular and emergency basis during the warranty period.

## 2.2 GENERAL EQUIPMENT REQUIREMENTS

### 2.2.1 Electrical and Electronic Devices

All electrical, electronic, and electro-pneumatic devices not located within an HVAC control panel shall have a NEMA Type 1 enclosure in accordance with NEMA 250 unless otherwise shown.

### 2.2.2 Standard Signals

The output of all analog transmitters and the analog input and output of all single-loop controllers and function modules shall be 4-to-20 mA dc signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

### 2.2.3 Ambient Temperature Limits

Ambient Temperature Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of 40 to 140 degrees F. All panel-mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. All devices installed outdoors shall operate within limit ratings of minus 40 to plus 150 degrees F.

### 2.2.4 Nameplates, Lens Caps, and Tag Nameplates

Nameplates, lens caps, and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each air flow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

### 2.2.5 Year 2000 Compliance

All equipment shall be Year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if other information technology properly exchanges date/time data with it.

## 2.3 MATERIALS

### 2.3.1 Tubing

#### 2.3.1.1 Copper

Copper tubing shall conform to ASTM B 88 and shall have sweat fittings and valves.

### 2.3.2 Wiring

#### 2.3.2.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

#### 2.3.2.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

#### 2.3.2.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

#### 2.3.2.4 Analog Signal Wiring Circuits

Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-volt service.

#### 2.3.2.5 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

#### 2.3.2.6 Nonconducting Wiring Duct

Nonconducting wiring duct in control panels shall have wiring duct in control panels shall have slotted sides, snap-on duct covers, have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips.

#### 2.3.2.7 Transformers

Step-down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformers shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508.

### 2.4 ACTUATORS

Actuators shall be pneumatic, electric and electronic as shown and shall be provided with mounting and connecting hardware. Contractor shall have the option of utilizing pneumatic systems in the Inspection Building (See Control Sequences). Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. Electric actuators shall have an oil-immersed gear train. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric or electronic actuators used in sequencing applications shall have an adjustable operating range and start point. Pneumatic actuators shall be rated for 25 psig operating pressure except for high-pressure cylinder-type actuators.

#### 2.4.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

#### 2.4.2 Positive Positioners

Positive positioners are required for pneumatic actuators. Each positive positioner shall be a pneumatic relay with a mechanical feedback mechanism and an adjustable operating range and starting point.

## 2.5 AUTOMATIC CONTROL VALVES

### 2.5.1 Valve Assembly

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv.

### 2.5.2 NOT USED

### 2.5.3 NOT USED

### 2.5.4 NOT USED

### 2.5.5 NOT USED

### 2.5.6 Solenoid Valve for Water Storage Tank Fill

Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Valve Cv shall be within 100 percent to 125 percent of the Cv shown. Internal valve trim shall be brass or bronze except that valve stems may be type 316 stainless steel.

## 2.6 DAMPERS

### 2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.

#### 2.6.1.1 Operating Links

Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

#### 2.6.1.2 Damper Types

Dampers shall be parallel blade type.

### 2.6.2 NOT USED

### 2.6.3 Mechanical and Electrical Space Ventilation Dampers

The dampers shall be as shown. Dampers shall not leak in excess of 80 cfm per square foot at 4 inches water (gauge) static pressure when closed. Dampers shall be rated at not less than 1500 fpm air velocity.

### 2.6.4 NOT USED

### 2.6.5 Damper End Switches

Each end switch shall be a hermetically-sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

## 2.7 DUCT SMOKE DETECTORS

Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the HVAC control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as each affected fan unit shall be properly identified in etched rigid plastic placards.

## 2.8 INSTRUMENTATION

### 2.8.1 Measurements

Transmitters shall be factory calibrated to provide an output of 4 to 20 mAdc over the indicated ranges:

- a. Relative humidity, 0 to 100 percent for space and duct high-limit applications.

### 2.8.2 NOT USED

### 2.8.3 Relative-Humidity Instruments

A relative-humidity instrument for indoor application shall have a measurement range from 0 to 100 percent relative-humidity and be rated for operation at ambient air temperatures within the range of 25 to 130 degrees F. It shall be capable of being exposed to a condensing air stream 100 percent RH with no adverse effect to the sensor's calibration or other harm to the instrument. The instrument shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Instruments used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted instruments shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The instrument (sensing element and transmitter) shall be a 2-wire, loop-powered device and shall have an accuracy of plus or minus 3 percent of full scale within the range of 20 to 80 percent relative humidity. The instrument shall have a typical long-term stability of 1 percent or less drift per year. The transmitter shall convert the sensing element's output to a linear 4-20 mAdc output signal in proportion to the measured relative-humidity value. The transmitter shall include offset and span

adjustments.

2.8.4 NOT USED

2.8.5 NOT USED

2.8.6 NOT USED

2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension-type well, and inside diameter and insertion length as required for the application.

2.9 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric.

2.9.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT) or DPDT as required, hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards). Thermostats shall have manual switches as required by the application.

2.9.2 Microprocessor-Based Room Thermostats

Microprocessor-based thermostats shall have built-in keypads for scheduling of day and night temperature settings. Access to the scheduling mode shall be by a password control code. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all 7 days of the week. The time program shall allow 2 separate temperature-setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for 1 year in the event of a power outage. Maximum differential shall be 2 degrees F. When used for heat-pump applications, the thermostat shall have an emergency heat switch. Thermostats shall have auxillary relay(s) as required by the control sequence.

2.9.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards).

2.9.4 NOT USED

2.9.5 NOT USED

2.9.6 NOT USED

2.9.7 Fan-Coil Unit Room Thermostats

#### 2.9.7.1 Heating Thermostats

Fan-coil heating thermostats shall be provided with fixed heat anticipation and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set maximum of 72 degrees F. Heating thermostats shall have an adjustable range of at least 13 degrees below 72 degrees F.

#### 2.9.7.2 Cooling Thermostats

Fan-coil cooling thermostats shall be provided with fixed cooling anticipation heater and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set minimum of 78 degrees F. Cooling thermostats shall have an adjustable range of at least 7 degrees F above 78 degrees F.

#### 2.9.7.3 Dual Element Thermostats

Fan-coil unit combination heating-cooling thermostats shall be provided with separate temperature sensing elements for each system, and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Each element shall operate switches to provide single stage control for heating and cooling. Heating and cooling circuits shall be electrically isolated from each other. Scales and ranges shall be as specified for individual thermostats. Thermostats shall contain, or a subbase shall be provided which contains, selector switches for Heat-Off-Cool. A changeover controller providing automatic summer-winter changeover for thermostats by sensing the supplied fluid temperature shall be provided. A limited range heating-cooling dead band thermostat shall control cooling when temperature is above the upper setpoint and heating when temperature is below the lower setpoint and shall have a dead band, with no heating or cooling, when temperature is between the setpoints. Setpoint adjustment shall be concealed.

### 2.10 PRESSURE SWITCHES AND SOLENOID VALVES

#### 2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

#### 2.10.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

#### 2.10.3 Pneumatic Electric (PE) Switches

Each switch shall have an adjustable setpoint range of 3 to 20 psig with a switching differential adjustable from 2 to 5 psig. The switch action shall be SPDT.

#### 2.10.4 Solenoid-Operated Pneumatic (EP) Valves

Each valve shall have three-port operation: common, normally open, and normally closed. Each valve shall have an outer cast-aluminum body and

internal parts of brass, bronze, or stainless steel. The air connection shall be a 3/8 inch NPT threaded connection. Valves shall be rated for 50 psig when used in a control system that operates at 25 psig or less, or 150 psig when used in a control system that operates in the range of 25 to 100 psig.

## 2.11 INDICATING DEVICES

### 2.11.1 Thermometers

#### 2.11.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

#### 2.11.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

#### 2.11.1.3 Non-Averaging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism. Install for operations Building AC-1, supply and return air.

#### 2.11.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

#### 2.11.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Thermometers shall have a range suitable for the application.

### 2.11.2 Pressure Gauges

Gauges shall be 2 inch (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 3 percent of scale range. Gauges shall meet requirements of ASME B40.1.

#### 2.11.2.1 Pneumatic Actuator Gauges

Field mounted gauges for indicating signal input to pneumatic actuators shall have a scale of 0 to 30 psig with 1 psig graduations.

#### 2.11.2.2 Air Storage Tank, Filter, and Dryer Gauges

Gauges for air storage tanks, or for use before and after dryers or dirt and oil filters, shall have a scale of 0 to 160 psig with 2 psig graduations.

#### 2.11.2.3 NOT USED

#### 2.11.2.4 Control Panel Pressure Gauges

Panel mounted air pressure gauges shall have a scale of 0 to 30 psig with 1 psig graduations.

### 2.11.3 Low Differential Pressure Gauges

Gauges for low differential-pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

## 2.12 SINGLE-LOOP CONTROLLERS

### 2.12.1 Controller Features

The controller shall be a microprocessor-based single-loop device that does not require Contractor generated software. The controller shall be mountable in a panel cutout measuring 3.62 by 3.62 inches. The controller shall have field scalable process variable, a remote setpoint analog input and an analog output with adjustable high and low end limits and proportional control manual reset adjustment. The analog output shall result from proportional, integral and derivative (PID) control. The analog output shall be configurable as direct acting and reverse acting. The controller shall have keyboard, display, auto/manual selection for control of its analog output, remote setpoint adjustment/local setpoint adjustment selection with adjustable high-end and low-end limits, ratio and bias adjustments on remote setpoint input, operator-initiated self-tune/manual-tune selection, anti-reset wind-up feature, and 2 independent SPDT contact-closure outputs (PV alarm and deviation alarm). The controller shall be configurable to power-up in automatic with local setpoint control and in automatic with remote setpoint control. The range of hysteresis adjustment shall be not smaller than from 1 percent to 5 percent of process variable input span. The controller shall power the analog output loop to 20 milliamperes when connected to a load of 600 ohms. The controller shall be capable of retransmitting the process variable to 20 milliamperes when connected to 600 ohms. The controller shall have 5-year battery backup to store operating parameters or shall have nonvolatile memory.

### 2.12.2 Parameter Input and Display

Control parameters shall be entered and displayed directly, in the correct engineering units, through a series of keystrokes on a front-panel display with a 3-1/2 digit, 7-segment display, with decimal point and polarity indication. The use of this display shall allow manual interrogation of setpoint, mode constants, and values of the process variable and output.

### 2.12.3 Controller Electrical Requirements

Each controller shall be powered by 120 volts ac. Power consumption shall not be greater than 25 watts. Each controller shall provide electrical noise isolation between the ac power line and the process variable input, remote setpoint input, and output signals and of not less than 100 db at 60 Hz common-mode rejection ratio, and not less than 60 db at 60 Hz normal-mode rejection ratio.

### 2.12.4 Controller Accuracy

The controller shall have an accuracy of plus or minus 0.30 percent of input span, plus or minus 1 digit.

### 2.12.5 Self-Tuning

The controller self-tuning operation shall apply proportional, integral, and derivative modes of control and shall modify the mode constants as required. Self-tuning shall only be in operation when selected from the front panel.

### 2.12.6 Manual-Tuning

The controller manual-tuning operation shall provide proportional, integral, and derivative control modes, or any combination thereof, by means of individual mode constant adjustments. These adjustments shall be set for the appropriate value if a particular control mode action is desired, or to zero if that particular mode is not desired. The proportional-mode constant shall be adjustable from 0 to 200 percent of input signal range, the integral-mode constant shall be adjustable from 0 to 20 repeats per minute, and derivative-mode constant shall be adjustable from 0 to 5 minutes.

## 2.13 CONTROL DEVICES AND ACCESSORIES

Control device and accessory input impedance shall not exceed 250 ohms.

### 2.13.1 Function Modules

Function modules shall accept mAdc analog input signals to produce mAdc analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs. Module output span accuracy shall be plus or minus 1 percent of input span. Modules shall be rail-mounted as shown. Power consumption shall be not greater than 5 watts.

#### 2.13.1.1 Minimum-Position Switch and Temperature-Setpoint Device

Minimum-position switch and temperature-setpoint device shall accept a 1000 ohms potentiometer input and shall produce a steady analog output. In temperature setpoint applications the potentiometer shall be single-turn, suitable for wall mounting, enclosed in a locking metal or heavy duty plastic enclosure and shall have a graduated dial corresponding to the range of the setpoint adjustment. In a minimum position switch application the potentiometer shall be mounted on or internal to the minimum position switch. The device shall have its input signal electrically or optically isolated from output. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

#### 2.13.1.2 Signal-Inverter Modules

Signal inverter shall accept an analog input signal and shall have sufficient output capacity to drive the output signal through a circuit with an impedance of not less than 600 ohms. The output shall be electrically isolated from the input and the device shall have a moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

#### 2.13.1.3 High-Low Signal Selector

High-low signal-selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal. The signal selector shall be powered by 120 Vac and the output signal shall be electrically isolated from the input signal.

#### 2.13.1.4 Sequencer Modules (Dual Limit Alarm)

Sequencer modules (dual limit alarms) shall accept an analog input signal and shall provide two contact closure outputs. Each output shall have an adjustable independent contact setpoint with an adjustable switching differential range between 1 percent and 100 percent of the input span. The setpoint shall be adjustable between 0 percent and 100 percent of the input span. Setpoint and switching differential (dead band) adjustment potentiometers shall be internal, top-accessed potentiometers or screws. Sequencers shall return all contacts to their zero input signal condition

when power is interrupted. The device shall have moisture resistant coating.

#### 2.13.1.5 Loop Driver Modules

Loop driver module shall accept an analog input signal and shall have a circuit input impedance not greater than 100 ohms. The loop driver module shall have sufficient output capacity to drive the output signal through a circuit with an impedance range of not less than 1000 ohms. The output shall be electrically isolated from the input and the device shall have moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8 output signal.

#### 2.13.2 Relays

Relays shall be 2-pole, double-throw (2PDT) with a 10-ampere resistive rating at 120 Vac, and shall have an enclosed 120-Vac coil with 8 pin blade connectors, and a matching rail-mounted socket. Power consumption shall not be greater than 3 watts.

#### 2.13.3 Time-Delay Relays

Time delay relays shall be 2PDT with 8 pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall be not greater than 3 watts.

#### 2.13.4 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors. The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

#### 2.13.5 NOT USED

#### 2.13.6 Current-to-Pneumatic (IP) Transducers

The transducers shall be 2-wire current-to-pressure transmitters that convert a 4-to-20 mA<sub>dc</sub> input signal to a 3 to 15 psig, or a 15 to 3 psig, pneumatic output, with a conversion accuracy of plus or minus 2 percent of full scale, including linearity and hysteresis. Input impedance shall not exceed 250 ohms. Air consumption shall not be greater than 0.25 scfm.

#### 2.13.7 Direct Current (DC) Power Supply

One DC power supply shall be used to power all transmitters connected to the control panel. The power supply shall be 24 V<sub>dc</sub> at not less than 1.2 amperes, with a peak-to-peak ripple not to exceed 0.03 percent of output voltage. Each power supply shall have a fused input, and shall be protected from voltage surges and powerline transients. The power supply output shall be protected against overvoltage and short circuits.

#### 2.14 PILOT LIGHTS AND MANUAL SWITCHES

Pilot lights and switches shall be rectangular devices arranged in a horizontal matrix as shown. Momentary switches shall be non-illuminated. Interlocking switches shall have separately illuminated sections. Split legend lights shall have separately illuminated sections. Device illumination shall be by light-emitting diode or neon lamp.

#### 2.15 HVAC SYSTEM AND PUMPHOUSE CONTROL PANELS

##### 2.15.1 Panel Assembly

The control panel shall be factory assembled and shipped to the job site as a single unit. The panel shall be fabricated as shown, and the devices shall be mounted as shown. Each panel shall be fabricated as a bottom-entry connection point for control-system electric power, control-system main air source, control-system wiring, pneumatic tubing, interconnection of control systems, interconnection of starters and external shutdown devices, and energy monitoring and control systems (EMCS) interface. Each panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

#### 2.15.2 Panel Electrical Requirements

Each control panel shall be powered by nominal 120 volts ac, fused at 5 amps, terminating at the panel on terminal blocks. Instrument cases shall be grounded. Interior panel, interior door, and exterior panel enclosure shall be grounded.

#### 2.15.3 Enclosure

The enclosure for each panel shall be a NEMA 12 single-door wall-mounted box conforming to NEMA 250, with continuous hinged and gasketed exterior door with print pocket and key lock, continuous hinged interior door, interior back panel, and ventilation louvers in back surface as shown. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

#### 2.15.4 Mounting and Labeling

Controllers, pilot lights, switches, IP's, and pressure gauge shall be mounted on the interior door as shown. Power conditioner, fuses and duplex outlet shall be mounted on the interior of the cabinet as shown. All other components housed in the panel shall be mounted on the interior back panel surface of the enclosure, behind the door on rails as shown. Controllers and gauges mounted on the front of the inner door shall be identified by a plastic or metal nameplate as shown that is mechanically attached to the panel. Function modules, relays, timeclocks, IP transducers, DC power supply, and other devices interior to the panel shall be identified by a plastic or metal nameplate that is mechanically attached to the panel. The nameplate shall have the inscription as shown. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch, and shall show a contrasting color, produced by filling with enamel or lacquer or by the use of a laminated material. Painting of lettering directly on the surface of the interior door or panel is not permitted.

#### 2.15.5 Wiring and Tubing

##### 2.15.5.1 Current-to-Pneumatic Transducers (IP)

Current-to-pneumatic transducers (IP) shall be piped to bulkhead fittings in the bottom of the panel with a 2 inch loop to accommodate IP replacement and shall be wired to identified terminal blocks.

##### 2.15.5.2 Panel Wiring

Interconnections Wiring shall be installed in wiring ducts in such a way that devices can be added or replaced without disturbing wiring that is not affected by the change. Wiring to all devices shall have a 4 inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. All interconnections required for power or signals shall be made on device terminals or panel terminal blocks, with not more than two wires connected to a terminal.

##### 2.15.5.3 Panel Terminal Blocks

Terminal blocks shall be arranged in groups such that all connections

(power, ground shield, etc.) for a given device are adjacent. Instrument signal grounds at the same ground reference level shall end at a grounding terminal for connection to a common ground point. Wiring-shield grounds at the same reference level shall end at a grounding terminal for connection to a common ground point. Grounding terminal blocks shall be identified by reference level.

#### 2.15.5.4 Wiring Identification

All wiring connected to controllers, time clocks and function modules shall be identified by function and polarity with full word identifiers, i.e., process variable input, remote setpoint input and control output.

### 2.16 COMPRESSED-AIR STATIONS (CONTRACTOR'S OPTION: INSPECTION BUILDING ONLY)

#### 2.16.1 Air-Compressor Assembly

The air compressor shall be a high-pressure compressing unit with electric motor. The compressor shall be equipped with a motor with totally enclosed belt guard, an operating-pressure switch, safety-relief valves, gauges, intake filter and intake silencer, and combination type magnetic starter with undervoltage protection and thermal-overload protection for each phase, and shall be supported by a steel base mounted on an air storage tank. The air compressor shall provide the compressed air required for control operation while operating not more than one-third of the time. The air storage tank shall be fabricated for a working pressure of not less than 200 psig, and constructed and certified in accordance with ASME BPV VIII Div 1. The tank shall be of sufficient volume so that no more than six compressor starts per hour are required with the starting pressure switch differential set at 20 psig. The tank shall be provided with an automatic condensate drain trap with manual override feature.

#### 2.16.2 Compressed-Air Station Specialties

##### 2.16.2.1 Refrigerated Dryer, Filters and, Pressure Regulator

A refrigerated dryer shall be provided in the air outlet line of the air storage tank. The dryer shall be of the size required for the full delivery capacity of the compressor. The air shall be dried at a pressure of not less than 70 psig to a temperature not greater than 35 degrees F. The dryer shall be provided with an automatic condensate drain trap with manual override feature. The refrigerant used in the dryer shall be one of the fluorocarbon gases and have an Ozone Depletion Potential of not more than 0.05. A 5 micron prefilter and coalescing-type 0.03 micron oil removal filter with shut-off valves shall be provided in the dryer discharge. Each filter bowl shall be rated for 150 psig maximum working pressure. A pressure regulator, with high side and low side pressure gauges, and a safety valve shall be provided downstream of the filter. Pressure regulators of the relieving type shall not be used.

##### 2.16.2.2 Flexible Pipe Connections

The flexible pipe connectors shall be designed for 150 psig and 250 degrees F service, and shall be constructed of rubber, tetrafluoroethylene resin, or braided corrosion-resistant steel, bronze, monel, or galvanized steel. The connectors shall be suitable for the service intended and may have threaded or soldered ends. The length of the connectors shall be as recommended by the manufacturer for the service intended.

##### 2.16.2.3 Vibration-Isolation Units

The vibration-isolation units shall be standard products with published loading ratings, and shall be single rubber-in-shear, double rubber-in-shear, or spring type.

#### 2.16.2.4 Compressed Air Piping

Control air delivered to the system shall conform to ISA S7.0.01. Air lines for pneumatic controls shall be seamless copper tubing. Copper tubing shall be hard-drawn in exposed areas and either hard-drawn or annealed in concealed areas. Only tool-made bands shall be used. Fittings for copper tubing shall be brass or copper solder joint type except at connections to apparatus, where fittings shall be brass compression type. Air lines concealed in walls shall be hard-drawn copper tubing or nonmetallic tubing in rigid conduit. Terminal single lines shall be hard-drawn copper tubing, except when the run is less than 12 inches in length, flexible polyethylene may be used.

#### 2.17 WATER STORAGE TANK HEATERS

Tank heaters shall be dry-well open coil element electric immersion heaters as manufactured by Chromalox (or approved equal); Chromalox model OCE-15042-3VXX5204, 4.2 Kw, 208V, 3PH, 60 HZ, nominal 15 foot long, for mounting in sch 40 pipe, 3" diameter. Heaters shall be wrapped with ceramic insulators, be removable within a 3 foot maintenance clearance, without draining the tank.

Tank heaters shall be furnished with Nema 4 weatherproof terminal boxes Chromalox model 16-122571 (or approved equal).

#### 2.18 WATER STORAGE TANK HEATER CONTROL PANEL

- a. Tank heater control system shall be custom designed to support the functions of temperature control, overtemperature control, low water protection as indicated, but not limited to below:
- b. Tank heater control panel shall be a U.L. listed digital indicating temperature and overtemperature controller, NEMA 12 enclosure. Control panel shall be completely factory wired, including main disconnect switch.
- c. Tank heater control panel shall be as manufactured by Chromalox (or approved equal); Chromalox model 4472-60660.
- d. Tank heater control panel shall include model 2104 1/4 DIN single loop temperature controller (with alarm contact and dual outputs), time out heater failure feature, hi limit control, control power transformer, and separate heater contactors.
- e. Tank Water temperature controller sensor and Water temperature high limit sensor shall be type J Spring loaded weatherproof thermocouples as manufactured by Chromalox (or approved equal); Chromalox model JS2AU12"NB7 with 3/4" NPT A260U10.5-304 stainless steel thermowells.
- f. Tank heater control loop shall include flanged chamber type low and high water level controls incorporating Mercoid model 102wt-4915-c-60 cast iron float chambers. All components of the assembly to be serviceable without draining the tank. Housing shall be weatherproof, and include flanged inspection plate as well as valved inlet for isolating the assembly from the tank.
- g. Coordinate all required openings with tank manufacturer(Section 13206 Steel Standpipes and Ground Storage Reservoirs)..Pay costs of any additional openings required in the tank.

Provide all control and power wiring and devices, other than shown in division 16.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION CRITERIA

The HVAC control system shall be installed and ready for operation, as specified and shown. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

##### 3.1.1 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with all required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

##### 3.1.2 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and HVAC control panels. Cables and conductors shall be tagged at both ends, with the identifier shown on the shop drawings, in accordance with the requirements of Division 16.

###### 3.1.2.1 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from powerline surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

###### 3.1.2.2 Surge Protection for Transmitter and Control Wiring

HVAC system control panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

- a. A 10-microsecond by 1000-microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8-microsecond by 20-microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

###### 3.1.2.3 Controller Output Loop Impedance Limitation

Controller output loops shall be constructed so that total circuit impedance connected to the analog output of a single-loop controller shall not exceed 600 ohms.

#### 3.2 CONTROL SYSTEM INSTALLATION

##### 3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators

operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

### 3.2.2 Local Gauges for Actuators

Pneumatic actuators shall have an accessible and visible receiver gauge installed in the tubing lines at the actuator as shown.

### 3.2.3 Room-Instrument Mounting

Room instruments shall be mounted so that their sensing elements are 5 feet above the finished floor unless otherwise shown. Temperature setpoint device shall be recess mounted.

### 3.2.4 Smoke Detectors

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A.

### 3.2.5 Manual Emergency Fan Shutdown Switches

Manual emergency fan shutdown switches shall be provided for air distribution fans in accordance with NFPA 90A. Switches shall be the manual-reset type. Switches shall be located and mounted in an accessible manner, approximately 48 inches above the finished floor. Switches shall be properly identified in etched rigid plastic placards.

### 3.2.6 Low-Temperature-Protection Thermostats

For each 20 square feet of coil-face area, or fraction thereof, a thermostat shall be provided to sense the temperature at the location shown. The thermostat sensing element shall be installed in a serpentine pattern.

### 3.2.7 Averaging-Temperature Sensing Elements

Sensing elements shall have a total-element minimum length equal to one linear foot per square foot of duct cross-sectional area.

### 3.2.8 Foundations and Housekeeping Pads

Foundations and housekeeping pads shall be provided for the HVAC control system air compressors.

### 3.2.9 Compressed-Air Stations

The air-compressor assembly shall be mounted on vibration eliminators, in accordance with ASME BPV VIII Div 1 for tank clearance. The air line shall be connected to the tank with a flexible pipe connector. Compressed-air-station specialties shall be installed with all required tubing, including condensate tubing to a floor drain.

### 3.2.10 NOT USED

### 3.2.11 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

### 3.2.12 Control System Tubing

The control system shall be installed so that pneumatic lines are not exposed to outside-air temperatures. Air lines shall be concealed except in mechanical rooms and other areas where other tubing and piping is exposed. All tubes and tube bundles exposed to view shall be installed neatly in lines parallel to the lines of the building. Tubing between panels and actuators in mechanical/electrical spaces shall be routed so that the lines are easily traceable. Air lines shall be tested periodically for leaks during installation. Air lines shall be purged of dirt, impurities and moisture before connecting to the control equipment. Air lines shall be number coded or color coded and keyed to the submittal drawings for future identification and servicing the control system.

#### 3.2.12.1 Pneumatic Lines

In mechanical/electrical spaces, pneumatic lines shall be copper tubing. Horizontal and vertical runs of soft copper tubes shall be installed in raceways dedicated to tubing. The dedicated raceways shall be supported every 6 feet for horizontal runs and every 8 feet for vertical runs. Tubing not installed in raceways shall be hard-drawn copper tubing with sweat fittings and valves, supported every 6 feet for horizontal runs and every 8 feet for vertical runs.

#### 3.2.12.2 Pneumatic Lines External To Mechanical/Electrical Spaces

Tubing external to mechanical/electrical spaces, when run in plenum ceilings, shall be soft copper with sweat fittings, supported every 8 feet. Tubing not in plenum spaces shall be soft copper with sweat fittings supported every 8 feet or shall be plastic tubing in raceways dedicated to tubing.

#### 3.2.12.3 Connection to Liquid and Steam Lines

Tubing for connection of sensing elements and transmitters to liquid and steam lines shall be copper with brass compression fittings.

#### 3.2.12.4 Connection to Ductwork

Tubing for connection of sensing elements and transmitters to ductwork shall be plastic tubing.

#### 3.2.12.5 Tubing in Concrete

Tubing in concrete shall be installed in rigid conduit. Tubing in walls containing insulation, fill, or other packing materials shall be installed in raceways dedicated to tubing.

#### 3.2.12.6 Final Connection to Actuators

Final connections to actuators shall be plastic tubing 12 inches long and unsupported at the actuator.

#### 3.2.12.7 Connection to HVAC Control Panel

A manual valve shall be provided at each HVAC control panel to allow shutoff of main air. Pneumatic connections to HVAC control panels shall be made at bulkhead fittings. Final connections to HVAC control panel bulkhead fitting shall be exposed tubing approximately 12 inches long.

### 3.3 SEQUENCE OF OPERATION

#### 3.3.1 Inspection Building

##### 3.3.1.1 Electrical Hazard Rating

Exercise caution in selecting controls for bays 101, 102 and 103. The

controls in these bays shall maintain the hazard rating for class II, Division 1 and 2, groups E,F and G per the NEC. The mechanical room does not have a hazard rating, but installation shall not compromise the hazard ratings of the three bays.

#### 3.3.1.2 Pneumatic Option

At the contractors option, controls may be pneumatic for bays 101, 102 and 103. Contractor to furnish air compressor and refrigerated drier as well as all necessary control devices and power wiring for the pneumatic system, if this option is taken. A breaker suitable for 5 hp has been indicated for this purpose.

#### 3.3.1.3 Heating and Ventilation - Bays 101,102 and 103

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 75 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 68 deg F, the thermostat shall start the electric unit heater and heat until the temperature rises to 72 deg F.

#### 3.3.1.3.# Thermostat

One 24 volt hazard-rated thermostat shall provide both heating and cooling functions for each unit heater/fan combination..

#### 3.3.1.4 Heating and Ventilation - Mechanical Room

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 55 deg F, the unit mounted thermostat shall start the electric unit heater and heat until the temperature rises to 55 deg F.

#### 3.3.2 Residue Building

##### 3.3.2.1 Heating and Ventilation - Bays 101 and 102

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 75 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 68 deg F, the thermostat shall start the electric unit heater and heat until the

temperature rises to 72 deg F.

#### 3.3.2.1.# Thermostat

One 24 volt programmable thermostat shall provide both heating and cooling functions.

#### 3.3.2.2 Heating and Ventilation - Mechanical Room

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 55 deg F, the unit mounted thermostat shall start the electric unit heater and heat until the temperature rises to 55 deg F.

#### 3.3.2.3 Restroom Fan

Fans to be interlocked with light switches.

#### 3.3.2.4 Restroom Heater

On a fall in space temperature below the setpoint of 68 deg F, the unit mounted thermostat shall start the electric unit heater and heat until the temperature rises to 72 deg F.

#### 3.3.2.5 Heating and Air Conditioning - PTAC

##### Setpoints:

Occupied mode shall be initiated by programmable room thermostat. Occupied temperature shall be 75 degree F cooling; 68 deg F heating. Unoccupied temperature shall be 80 degree F cooling; 65 deg F heating.

##### Ventilation:

Outside air damper shall be enabled to open during occupied mode and remain closed during the unoccupied mode. Damper shall open only when the unit compressor runs.

##### Fan Operation:

Fan shall run continuous in occupied modes, and cycle during unoccupied modes.

##### Sequence:

PTAC controls shall be as specified; unit shall maintain temperatures indicated, and stage auxiliary heat as required to maintain setpoint.

#### 3.3.2.6 Forklift Charging Station Exhaust Fans

Sail switch shall verify flow and enable the forklift charging system(s).

### 3.3.3 Operations Building

#### 3.3.3.1 Heating and Ventilation - Mechanical Room

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

Heating:

On a fall in space temperature below the setpoint of 55 deg F, the thermostat shall start the electric unit heater and heat until the temperature rises to 55 deg F.

#### 3.3.3.1.# Thermostat

One 24 volt thermostat shall provide both heating and cooling functions.

#### 3.3.3.2 Restroom Fan

Fan to be interlocked with women's room light switch.

#### 3.3.3.3 Heating and Air Conditioning - AC-1 and HP-1

Setpoints:

Occupied mode shall be initiated by programmable room thermostat. Occupied temperature shall be 75 degree F cooling; 68 deg F heating. Unoccupied temperature shall be 80 degree F cooling; 65 deg F heating.

Ventilation:

Outside air damper shall be enabled to open during occupied mode and remain closed during the unoccupied mode.

Fan Operation:

Fan shall run continuous in occupied modes, and cycle during unoccupied modes.

Sequence:

Split system controls shall be as specified; unit shall maintain temperatures indicated, and stage auxiliary heat as required to maintain setpoint. Duct smoke detector shall shut down the fan on sensing smoke. Detector shall have contacts for initiating a fire alarm.

#### 3.3.4 Pumphouse

##### 3.3.4.1 Heating and Ventilation

Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

Heating:

On a fall in space temperature below the setpoint of 55 deg F, the thermostat shall start the electric unit heater and heat until the temperature rises to 60 deg F.

##### 3.3.4.1.# Thermostat

One 24 volt thermostat shall provide both heating and cooling functions.

### 3.3.4.2 Tank Immersion Heater Control and Control Panel

#### 3.3.4.2 Sequence

On a fall in tank temperature sensed by the thermocouple, below the setpoint of 35 deg F, the heater controller shall start the electric tank immersion heaters and heat until the temperature rises to 45 deg F. A high limit Thermocouple shall not allow the tank temperature to rise above 55 deg F. A low water level switch shall lockout the heaters on sensing low water in the tank. Failure of any one heater shall not disable the remaining heaters. A green light shall indicate that the tank heaters are functioning. A red alarm light shall indicate a failure of the heaters to maintain temperature in the tank and sound an exterior alarm horn at 33 deg F.

### 3.3.4.3 Well Pump and Control Panel

#### 3.3.4.3.# Sequence

The well pump shall start on a drop in line pressure below setpoint of 55 psi, as sensed by a pressure switch in the pumphouse well water supply line. Pump shall stop on a rise in line pressure to 65 psi.

#### 3.3.4.3.# Responsibility

Division 16 contractor furnishes and installs a well pump motor starter, and starter power wiring.

Well pump control panel shall be furnished and installed under this section. Panel shall include all wiring and devices, including control transformers, relays and accessories to perform the desired functions.

### 3.3.4.4 Tank Fill Controls

#### 3.3.4.4.# Sequence

A mechanical spring-type altitude valve (specified in section 13206, installed under division 15) shall be set to open whenever the head pressure is such that the tank water level is below the minimum fill height. Valve shall close just prior to water reaching the height of the tank overflow. Valve shall be listed for use on the fire water system. A solenoid valve in parallel with the altitude valve shall provide redundant fill control. The solenoid valve shall open whenever the water level drops below the minimum fill height, as sensed by the upper water level switch.

#### 3.3.4.4.# Freeze Protection

Install 5 watt per foot heat tracing from fill panel to upper water level switch, to protect against freezing. Chromalox type SRL, 120 volt or equivalent cable. Install in conduit up to switch.

#### 3.3.4.4.# Fire Pump Control

A low level switch (same as specified for tank fill) in the tank shall disable the fire pump, sound an alarm and turn on an indicating light signaling low water (tank level less than 12" above tank bottom). Fire pump control shall incorporate a sequence and device to open the mechanical room intake damper to allow for combustion air from outside.

## SECTION 15990

## TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

## NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01 (1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

TAB Related HVAC Submittals; FIO.

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

## SD-04 Drawings

TAB Schematic Drawings and Report Forms; GA.

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

## SD-06 Instructions

TAB Procedures; GA.

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

## SD-07 Schedules

Systems Readiness Check; FIO.

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; GA.

Proposed date and time to begin field measurements, making adjustments,

etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; GA.

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

#### SD-08 Statements

TAB Firm; GA.

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist; GA.

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

Instrument Calibration; FIO.

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

#### SD-09 Reports

Design Review Report; GA.

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check Report; GA.

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; GA.

Three copies of the completed TAB Reports, no later than 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; GA.

Three copies of the completed TAB Verification Report, no later than 7 days after the execution of TAB Verification. All items in the TAB Verification

Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-13 Certificates

Ductwork Leak Testing; FIO.

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard Adjusting Systems.	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing Balancing of Environmental
TAB Specialist	TAB Engineer	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1or NEBB-01, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor, and shall report to and be paid by the prime Contractor.

#### 1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

#### 1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995 COMMISSIONING OF HVAC SYSTEMS.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

##### 3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

### 3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

### 3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

### 3.5 TESTING, ADJUSTING, AND BALANCING

#### 3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

#### 3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

#### 3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

#### 3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

#### 3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

#### 3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --

SECTION 16120  
INSULATED WIRE AND CABLE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

- |          |   |
|----------|---|
| AEIC CS5 | (Oct 1987; 9th Ed) Thermoplastic and Crosslinked Polyethylene Insulated Shielded Power Cables Rated 5 Through 35 kV |
| AEIC CS6 | (Oct 1987; 5th Ed; Rev Mar 1989) Ethylene Propylene Insulated Shielded Power Cables Rated 5 Through 69 kV           |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- |              |   |
|--------------|---|
| IEEE Std 383 | (1974; R 1992) Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations |
|--------------|---|

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |           |  |
|-----------|--|
| NEMA WC 7 | (1988) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy |
| NEMA WC 8 | (1988) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy               |

## 1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Installation Instructions; FIO.

The Contractor shall submit cable manufacturing data [as requested].

## SD-09 Reports

Tests, Inspections, and Verifications; FIO.

6 certified copies of test reports shall be submitted by the contractor.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length,

voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices.

#### 1.4 PROJECT/SITE CONDITIONS

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 NOT USED

##### 2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with Table 3-1 of NEMA WC 7 or NEMA WC 8.

##### 2.1.3 Conductors

###### 2.1.3.1 Material

Conductors shall conform to all the applicable requirements of Section 2 of NEMA WC 7 or Part 2 of NEMA WC 8 as applicable and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

###### 2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in Table 3-1 of Section 3 of NEMA WC 7 or Part 3 of NEMA WC 8, as applicable.

###### 2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix L of NEMA WC 7 or NEMA WC 8, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

###### 2.1.3.4 Conductor Shielding

Conductor shielding conforming to paragraph 2.7 of NEMA WC 7 or NEMA WC 8, as applicable, shall be used on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC CS5 or AEIC CS6. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied insulation.

###### 2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

#### 2.1.4 Insulation

#### 2.1.4.1 Insulation Material

Insulation shall be cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of Section 3 or paragraph 7.7 of NEMA WC 7 as applicable, or an ethylene-propylene rubber (EPR) type meeting the requirements of Part 3 of NEMA WC 8. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

- a. XLPE, if used, shall be tree-retardant.
- b. Insulation shall be chemically bonded to conductor shielding.
- c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC CS5 or AEIC CS6, as applicable.
- d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable [unless specifically approved].

#### 2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

- a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by Table 3-1, Section 3 of NEMA WC 7 or Table 3-1, Part 3, of NEMA WC 8, as applicable. Column "A" thickness of Table 3-1 of NEMA WC 7 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 8 ethylene-propylene rubber-insulated conductors shall have a jacket. Column "B" thickness shall apply to single-conductor cables that require a jacket and to individual conductors of multiple-conductor cables with an overall jacket.
- b. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by Table 7-32 of NEMA WC 7 or Table 7.5.1 of NEMA WC 8 as applicable.

#### 2.1.5 Jackets

All cables shall have jackets meeting the requirements of Section 4 of NEMA WC 7, or Part 4 of NEMA WC 8, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

##### 2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Variations from the

materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. General Use

- (1) Heavy-duty black neoprene (NEMA WC 8, paragraph 4.4.3).
- (2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 8, paragraph 4.4.10).
- (3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 8, paragraph 4.4.11).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

- (1) General-purpose neoprene (NEMA WC 8, paragraph 4.4.4).
- (2) Black polyethylene (NEMA WC 8, paragraph 4.4.6).
- (3) Thermoplastic chlorinated polyethylene (NEMA WC 8, paragraph 4.4.7).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by Section 4, Table 4-6 of NEMA WC 7 or Part 4, Table 4-4 of NEMA WC 8, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 4, Table 4-7, of NEMA WC 7 or Part 4, Table 4-5, of NEMA WC 8.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in Section 4, Table 4-4 of NEMA WC 7 or Part 4, Table 4-2 of NEMA WC 8. If shielded, the jacket thickness shall be in accordance with the requirements of Section 4, Table 4-5 of NEMA WC 7 or Part 4, Table 4-3 of NEMA WC 8.

2.1.6 NOT USED

2.1.7 Identification

2.1.7.1 Color-coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with paragraph 5.3 of NEMA WC 8, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with Table 5-2 of NEMA WC 8. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included.

2.1.8 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to Part 5 of NEMA WC 8, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

#### 2.1.9 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

#### 2.2 INSTALLATION INSTRUCTIONS

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

- a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.
- b. Pulling tension and sidewall pressure limits, in pounds.
- c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.
- d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

#### 2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

##### 2.3.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

##### 2.3.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with Section 6 of NEMA WC 7 or Part 6 of NEMA WC 8. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

##### 2.3.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for

cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

#### 2.3.2.2 NOT USED

#### 2.3.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE Std 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 7, paragraph 7.7.3.1.3. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

#### 2.3.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

#### 2.3.2.5 Reports

Results of tests made shall be furnished. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

### PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 16375

## ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (FOG) Apparatus
ASTM C 478	(1996) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1996) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Electrical Equipment
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE Std 48(1996)	Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81(1983)	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

IEEE Std 100(1996) IEEE Standard Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1 (1993) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies

NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 467 (1993; Rev thru Aug 1996) Grounding and Bonding Equipment

UL 486A (1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486B (1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors

UL 510 (1994; Rev thru Nov 1997) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

UL 514A (1996) Metallic Outlet Boxes

UL 651 (1995; Rev thru Apr 1997) Schedule 40 and 80 Rigid PVC Conduit

UL 1242 (1996; Rev Apr 1997) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.3 SUBMITTALS

Governmental approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Catalog Data; GA.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

#### SD-04 Drawings

Electrical Distribution System; GA.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

- a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
- b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

As-Built Drawings; GA.

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

#### SD-09 Reports

#### Factory Test; GA.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

#### SD-13 Certificates

#### Materials and Equipment; GA.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

### 1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer

regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

## 2.2 NAMEPLATES

### 2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal.

## 2.3 CORROSION PROTECTION

### 2.3.1 NOT USED

### 2.3.2 Ferrous Metal Materials

#### 2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

#### 2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

### 2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

## 2.4 CABLES

### 2.4.1 NOT USED

### 2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

#### 2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

#### 2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

#### 2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

#### 2.4.2.4 NOT USED

#### 2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

### 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

#### 2.5.1 NOT USED

#### 2.5.2 NOT USED

#### 2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B.

Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

#### 2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

##### 2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level.

##### 2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 25 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

## 2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type or nonencased direct-burial, thick-wall type as shown on drawing.

### 2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

### 2.6.2 Nonmetallic Ducts

#### 2.6.2.1 NOT USED

#### 2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

#### 2.6.2.3 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 Type DB.

### 2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

## 2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

### 2.8 NOT USED

### 2.9 NOT USED

### 2.10 NOT USED

### 2.11 NOT USED

### 2.12 NOT USED

### 2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

#### 2.14 NOT USED

#### 2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

##### 2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

##### 2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

##### 2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

##### 3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

##### 3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or

set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc.

### 3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

#### 3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

#### 3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

#### 3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

#### 3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

#### 3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.

- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

### 3.2.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

### 3.2.3 NOT USED

#### 3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

#### 3.2.3.2 NOT USED

#### 3.2.3.3 Other Requirements

Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

#### 3.2.3.4 Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

#### 3.2.3.5 Cable Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. In addition to markers, a 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

### 3.2.4 NOT USED

### 3.2.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

### 3.3 NOT USED

### 3.4 NOT USED

### 3.5 DUCT LINES

#### 3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

#### 3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

#### 3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is

required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

#### 3.5.4 Nonencased Direct-Burial

Duct lines shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

#### 3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

##### 3.5.5.1 NOT USED

##### 3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

#### 3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

### 3.6 MANHOLES, HANDHOLES, AND PULLBOXES

#### 3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved

areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

### 3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

### 3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

### 3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

### 3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

### 3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 2/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

## 3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation,

surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

### 3.7.1 Concrete Pads

#### 3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

#### 3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

#### 3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

### 3.8 NOT USED

### 3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

### 3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, to the ground ring. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

#### 3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.
- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 12 inches, plus or minus 3 inches, below finished top of soil grade. Ground ring conductors shall be #2/0 AWG.
- d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three, 10 foot rods spaced a minimum of 10 feet apart, coupled and driven with the first rod. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

### 3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

### 3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

### 3.10.4 NOT USED

### 3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

## 3.11 FIELD TESTING

### 3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor,

and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

### 3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

### 3.11.3 Ground-Resistance Tests

The resistance of the ground ring or electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Ground ring - 10 ohms.

### 3.11.4 NOT USED

### 3.11.5 NOT USED

### 3.11.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$R$  in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

### 3.11.7 NOT USED

### 3.11.8 NOT USED

### 3.11.9 NOT USED

### 3.11.10 NOT USED

### 3.11.11 NOT USED

### 3.11.12 NOT USED

### 3.11.13 Operating Tests

After the installation is completed, and at such times as the Contracting

Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

### 3.12 MANUFACTURER'S FIELD SERVICE

#### 3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

#### 3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

### 3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

## SECTION 16403

## MOTOR CONTROL CENTERS, SWITCHBOARDS AND PANELBOARDS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B 187 (1994) Copper Bar, Bus Bar, Rod and Shapes  
ASTM B 317 (1992a) Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Shapes for Electrical Purposes (Bus Conductor)

## ASME INTERNATIONAL (ASME)

- ASME B1.1 (1989) Unified Inch Screw Threads (UN and UNR Thread Form)  
ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA AB 1 (1993) Molded Case Circuit Breakers and Molded Case Switches  
NEMA PB 1 (1990) Panelboards

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (1993) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

- UL 44 (1991; Rev thru Jan 1995) Rubber-Insulated Wires and Cables  
UL 50 (1992) Enclosures for Electrical Equipment  
UL 67 (1993; Rev thru May 1994) Panelboards  
UL 489 (1991; Rev thru Dec 1994) Molded Case Circuit Breakers and Circuit Breaker Enclosures  
UL 1063 (1993; Rev thru Oct 1994) Machine-Tool Wires and Cables

## 1.2 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

## 1.2.1 Rules

The equipment shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. The contractor shall immediately notify the Contracting Officer of any requirements of the specifications or contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

#### 1.2.2 Coordination

The general arrangement of the motor control centers, switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Contracting Officer. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory. The motor control centers and switchboards may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

#### 1.2.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the Contracting Officer, complete specifications for the materials which he proposes to use.

#### 1.2.4 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum approximately 4 millimeters (1/8 inch) thick, engraved to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 15 millimeters (1/2 inch) high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

- a. Panelboards
- b. Individually-mounted circuit breakers in Panelboard

Equipment of the withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation. Equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection. Submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA.

The Contractor shall within 30 calendar days after date of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Six (6) sets of characteristic curves of the individual breaker trip element shall be submitted.

#### SD-04 Drawings

Outline Drawings; GA.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

Panelboards; GA.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each switchboard and panelboard.

#### SD-08 Statements

Factory Tests; FIO.

The Contractor shall submit, within a minimum of 14 days prior to the proposed date of tests, six (6) copies of manufacturer's routine factory test procedures and production line tests for all motor control centers and switchboards.

#### SD-09 Reports

Factory Tests; FIO.

The Contractor shall submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Report shall be signed and dated by the Contractor's and Contracting Officer's Representatives.

### 1.4 DELIVERY, STORAGE, AND HANDLING

The equipment shall be shipped as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during

shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck.

## 1.5 MAINTENANCE

### 1.5.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus shall be furnished by the Contractor.

## PART 2 PRODUCTS

### 2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Contracting Officer, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

### 2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

#### 2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

#### 2.2.2 NOT USED

#### 2.2.3 120/240-Volt AC Circuits

Circuit breakers for 120-volt ac circuits shall be rated not less than 120/240 or 240 volts ac, and shall have a UL listed minimum interrupting capacity of 10,000 symmetrical amperes.

### 2.3 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW

meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings. Panelboards shall be fully rated for a short-circuit current of 22,000 symmetrical amperes RMS ac.

2.8.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than 3.5 millimeters (No. 10 gage) if flush-mounted or mounted outdoors, and not less than 2.7 millimeters (No. 12 gage) if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Outdoor cabinets shall be of NEMA 3R raintight and a removable steel plate 7 millimeters (1/4 inch) thick in the bottom for field drilling for conduit connections. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 3 millimeters (1/8 inch). Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 15 millimeter (1/2 inch) clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 600 millimeters (24 inches) long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph NAMEPLATES. Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

2.8.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper and shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187, and ASTM B 317. The sizes of buses

and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

### 2.8.3 Components

Each branch circuit, and the main buses where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Circuit breakers of the same frame size and rating shall be interchangeable.

### 2.9 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Grey. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph SPARE PARTS.

### 2.10 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Contracting Officer unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Contracting Officer to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Contracting Officer. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Contracting Officer. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

#### 2.10.1 NOT USED

#### 2.10.2 NOT USED

#### 2.10.3 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

### PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 16415

## ELECTRICAL WORK, INTERIOR

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C39.1 (1981; R 1992) Requirements for Electrical Analog Indicating Instruments
- ANSI C82.4 (1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B 1 (1995) Hard-Drawn Copper Wire
- ASTM B 8 (1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D 709 (1992; R 1997) Laminated Thermosetting Materials

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE ANSI/IEEE C57.13 (1993) Instrument Transformers
- IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA FU 1 (1986) Low Voltage Cartridge Fuses
- NEMA ICS 1 (1993) Industrial Control and Systems
- NEMA ICS 2 (1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
- NEMA ICS 3 (1993) Industrial Control and Systems Factory Built Assemblies
- NEMA ICS 6 (1993) Industrial Control and Systems Enclosures
- NEMA LE 4 (1987) Recessed Luminaires, Ceiling Compatibility

NEMA OS 1 (1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA OS 2 (1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

NEMA RN 1 (1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NEMA WD 1 (1983; R 1989) General Requirements for Wiring Devices

NEMA WD 6 (1988) Wiring Devices - Dimensional Requirements

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

NFPA 101 (1997; Errata 97-1) Life Safety Code

## UNDERWRITERS LABORATORIES (UL)

UL 1 (1993; Rev thru Jan 1995) Flexible Metal Conduit

UL 6 (1997) Rigid Metal Conduit

UL 50 (1995; Rev thru Oct 1997) Enclosures for Electrical Equipment

UL 83 (1996; Rev Sep 1997) Thermoplastic-Insulated Wires and Cables

UL 98 (1994; R thru Oct 1995) Enclosed and Dead-Front Switches

UL 198E (1988; Rev Jul 1988) Class R Fuses

UL 360 (1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit

UL 467 (1993; Rev thru Aug 1996) Grounding and Bonding Equipment

UL 486A (1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486C (1997) Splicing Wire Connectors

UL 498 (1996; Rev thru Nov 1997) Attachment Plugs and Receptacles

UL 508 (1993; Rev thru Oct 1997) Industrial Control Equipment

UL 510 (1994; Rev thru Nov 1997) Insulating Tape

UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1996) Metallic Outlet Boxes
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 514C	(1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994; Rev May 1997) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995; Rev thru Apr 1997) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev Sep 1996) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 698	(1995; Rev thru Dec 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 869A	(1993; Rev thru Apr 1996) Reference Standard for Service Equipment
UL 886	(1994; Rev thru Jan 1997) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 943	(1993; Rev thru Mar 1997) Ground-Fault Circuit-Interrupters
UL 1010	(1995; Rev thru Dec 1996) Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1029	(1994; Rev thru Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1242	(1996; Rev Apr 1997) Intermediate Metal Conduit
UL 1570	(1995; Rev thru Jun 1997) Fluorescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 97) High Intensity Discharge Lighting Fixtures
UL 1660	(1994; Rev Jan 1996) Liquid-Tight Flexible Nonmetallic Conduit
UL Elec Const Dir	(1997) Electrical Construction Equipment Directory

## 1.2 GENERAL

### 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

### 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible.

Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

### 1.2.3 Special Environments

#### 1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

#### 1.2.3.2 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70 for Class II, Division 1 and 2 hazardous locations. Equipment shall be suitable for Group E, F, and G.

#### 1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

### 1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 1.2.5 NAMEPLATES

#### 1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an

irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Starters	Control Power Transformers
Safety Switches	Control Devices
Equipment Enclosures	Instrument Transformers
Motors	

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Catalog; GA.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

SD-04 Drawings

Interior Electrical Equipment; GA.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional

items shall be clearly identified as included or excluded.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings; GA.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-08 Statements

Onsite Test; GA.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-09 Reports

Factory Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; GA.

A detailed description of the Contractor's proposed procedures for onsite test submitted 20 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

#### 1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

#### PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

##### 2.1 NOT USED

##### 2.2 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

##### 2.2.1 NOT USED

##### 2.2.2 NOT USED

##### 2.2.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

#### 2.2.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

#### 2.6 CIRCUIT BREAKERS

2.6.1 NOT USED

2.6.2 NOT USED

2.6.3 NOT USED

2.6.4 NOT USED

#### 2.6.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.6.6 NOT USED

2.6.7 NOT USED

#### 2.6.8 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.7 NOT USED

#### 2.8 CONDUIT AND TUBING

##### 2.8.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.8.2 NOT USED

##### 2.8.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

##### 2.8.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

##### 2.8.5 Intermediate Metal Conduit

UL 1242.

2.8.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.8.7 NOT USED

2.8.8 Rigid Metal Conduit

UL 6.

2.8.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.9 CONDUIT AND DEVICE BOXES AND FITTINGS

2.9.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514C.

2.9.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.9.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.9.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.9.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.9.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.9.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.10 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.11 CONNECTORS, WIRE PRESSURE

2.11.1 For Use With Copper Conductors

UL 486A.

2.12 NOT USED

2.13 ENCLOSURES

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

2.13.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.14 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.14.1 Fixture, Auxiliary or Emergency

UL 924.

2.14.2 NOT USED

2.14.3 Fluorescent

- a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

- b. Ballasts:

(1) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS\*

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
32W F32 T8	rapid or instant start	120 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

- c. Lampholders, Starters, and Starter Holders: UL 542.

2.14.4 High-Intensity-Discharge

- a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

- b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.15 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.15.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.15.2 NOT USED

2.15.3 NOT USED

2.15.4 NOT USED

## 2.15.5 Fuses, Class R

UL 198E.

## 2.15.6 NOT USED

## 2.15.7 NOT USED

## 2.15.8 NOT USED

## 2.15.9 Fuseholders

UL 512.

## 2.16 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

## 2.17 NOT USED

## 2.18 MOTOR CONTROLS

## 2.18.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

## 2.18.2 Motor Starters

Combination starters shall be provided as indicated.

## 2.18.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 25 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generated sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

## 2.18.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

## 2.18.4 Low-Voltage Motor Overload Relays

## 2.18.4.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the

requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds. Quick trip units shall be used on hermetically sealed, submersible pumps, and similar motors.

#### 2.18.4.2 Construction

Manual reset type thermal relay shall be melting alloy or bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

#### 2.18.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

#### 2.18.5 Automatic Control Devices

##### 2.18.5.1 NOT USED

##### 2.18.5.2 NOT USED

##### 2.18.5.3 Manual/Automatic Selection

- a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.
- b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.
- c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls voltages shall be coordinated with mechanical systems.

##### 2.19 NOT USED

#### 2.20 RECEPTACLES

##### 2.20.1 NOT USED

##### 2.20.2 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

## 2.20.3 Standard Grade

UL 498.

## 2.20.4 Ground Fault Interrupters

UL 943, Class A or B.

## 2.20.5 Hazardous (Classified) Locations

UL 1010.

## 2.20.6 NEMA Standard Receptacle Configurations

NEMA WD 6.

## a. Single and Duplex, 20-Ampere, 125 Volt

20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

## b. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

## c. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

## d. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

## e. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

## f. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

## 2.21 Service Entrance Equipment

UL 869A.

## 2.22 SPLICE, CONDUCTOR

UL 486C.

## 2.23 NOT USED

## 2.24 NOT USED

## 2.25 TAPES

## 2.25.1 Plastic Tape

UL 510.

#### 2.25.2 Rubber Tape

UL 510.

2.26 NOT USED

2.27 NOT USED

2.28 NOT USED

2.29 NOT USED

2.30 NOT USED

#### 2.31 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

### PART 3 EXECUTION

#### 3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

##### 3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 10 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

##### 3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

##### 3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment

grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

### 3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, and intermediate metal conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

#### 3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07270 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

##### 3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be

left at each end of the pull wire.

#### 3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

#### 3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

#### 3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

#### 3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

#### 3.2.1.6 Supports

Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways

shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

#### 3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

#### 3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

#### 3.2.1.9 NOT USED

#### 3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 Cables and Conductors

##### 3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

##### 3.2.4.2 NOT USED

##### 3.2.4.3 NOT USED

##### 3.2.4.4 NOT USED

##### 3.2.4.5 NOT USED

### 3.2.4.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made.

Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

- a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).

- b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.
- c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

### 3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

#### 3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes

may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

### 3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

### 3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

### 3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

## 3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be satin finish

corrosion resistant steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

### 3.5 RECEPTACLES

#### 3.5.1 Single and Duplex, 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

#### 3.5.2 NOT USED

#### 3.5.3 NOT USED

#### 3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

##### 3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

##### 3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

#### 3.5.5 NOT USED

#### 3.5.6 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with

appropriate mating cord-grip plug.

### 3.5.7 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, four-wire, grounding type, complete with appropriate mating cord-grip type attachment plug.

### 3.5.8 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

### 3.5.9 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, four-wire, grounding type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range.

### 3.5.10 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

### 3.5.11 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

## 3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120 or 277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

### 3.7 NOT USED

### 3.8 NOT USED

## 3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and

shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as shown or specified.

3.9.1 NOT USED

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 shall have tested interrupting capacity not less than 100,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.4 NOT USED

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 NOT USED

3.12 NOT USED

3.13 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual

control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.13.1 NOT USED

3.13.2 NOT USED

3.13.3 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.14 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.15 NOT USED

3.16 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.16.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.16.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.16.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall be as indicated and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.16.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be as shown.

3.16.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

#### 3.16.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

#### 3.16.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

#### 3.16.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

#### 3.16.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

#### 3.16.3 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

#### 3.17 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

#### 3.18 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the

specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

### 3.18.1 Motors and Motor Control

Motor controls shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motor controls, and terminated.

### 3.19 NOT USED

### 3.20 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

### 3.21 NOT USED

### 3.22 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

#### 3.22.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.22.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.
- b. Grounding electrode system - 10 ohms.

#### 3.22.3 Ground-System Connection Inspection

All below-grade ground-system connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 7 hours before the site is ready for inspection.

#### 3.22.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

$R$  in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

##### 3.22.4.1 NOT USED

##### 3.22.4.2 Low Voltage Cable Tests

- a. Continuity test.
- b. Insulation resistance test.

##### 3.22.5 NOT USED

##### 3.22.6 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.
- c. High potential test on each winding to ground.
- d. Insulation resistance of each winding to ground.
- e. Vibration test.
- f. Dielectric absorption test on motor [and starter].

##### 3.22.7 NOT USED

##### 3.22.8 NOT USED

##### 3.22.9 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

##### 3.22.9.1 NOT USED

##### 3.22.9.2 NOT USED

##### 3.22.9.3 Circuit Breakers, Molded Case

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test.
- d. Manual operation of the breaker.

##### 3.22.10 NOT USED

### 3.22.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE ANSI/IEEE C57.13.

### 3.23 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

### 3.24 NOT USED

### 3.25 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

## SECTION 16528

## EXTERIOR LIGHTING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO LTS-3 (1994) Standard Specifications for  
Structural Supports for Highway Signs,  
Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1375 (1990; R 1996) 400-Watt, M59 Single-Ended  
Metal-Halide Lamps

ANSI C78.1376 (1990; R 1996) 1000-Watt, M47 Metal-Halide  
Lamps

ANSI C82.4 (1992) Ballasts for  
High-Intensity-Discharge and Low-Pressure  
Sodium Lamps (Multiple-Supply Type)

ANSI C136.2 (1985) Luminaires, Voltage Classification  
of

ANSI C136.3 (1989) Luminaire Attachments - for Roadway  
Lighting Equipment

ANSI C136.6 (1990) Roadway Lighting Equipment - Metal  
Heads and Reflector Assemblies -  
Mechanical and Optical Interchangeability

ANSI C136.9 (1990) Roadway Lighting Equipment - Socket  
Support Assemblies for Use in Metal Heads  
- Mechanical Interchangeability

ANSI C136.10 (1995) Locking-type Photocontrol Devices  
and Mating Receptacles - Physical and  
Electrical Interchangeability and Testing  
for Roadway Lighting Equipment

ANSI C136.11 (1988; R 1994) Multiple Sockets for  
Roadway Lighting Equipment

ANSI C136.15 (1986) High-Intensity-Discharge and  
Low-Pressure Sodium Lamps in Luminaires -  
Field Identification

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings  
on Iron and Steel Products

ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 117	(1995) Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

## ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE ANSI/IEEE C136.13	(1987; R 1997) Metal Brackets for Wood Poles

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata) National Electrical Code
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## UNDERWRITERS LABORATORIES (UL)

UL 98	(1994; Rev Oct 1995) Enclosed and Dead-Front Switches
UL 1029	(1994; Rev Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1571	(1991; Rev thru Mar 1995) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures

## 1.2 SYSTEM DESCRIPTION

## 1.2.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

## 1.2.2 NOT USED

## 1.2.3 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.2.4 NOT USED

1.2.5 NOT USED

1.2.6 NOT USED

1.2.7 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.2.8 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.2.9 NOT USED

1.2.10 NOT USED

1.2.11 Protection of Security Lighting System Components

1.2.11.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways or by means of direct burial, as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaires mounted below 20 feet. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

1.3 CORROSION PROTECTION

1.3.1 NOT USED

1.3.2 Ferrous Metal Materials

1.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

1.3.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to

the manufacturer's standard.

### 1.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Equipment and Materials; GA.

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

#### SD-04 Drawings

Lighting System; GA.

Detail drawings for the complete system and for poles, lighting fixtures, and bracket arms.

- a. Lamp strike and restrike times.
- b. A typical zone layout showing light locations, isolux patterns, point by points, and lighting ratios.

As-Built Drawings; GA.

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

#### SD-09 Reports

Operating Test; GA.

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

### 2.2 BRACKET ARMS

#### 2.2.1 On Steel Poles

Poles shall be provided with bracket arms of the support arm style and of

the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE ANSI/IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 POLES

Metal poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of 80 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.11.1 NOT USED

2.11.2 Steel Poles

Steel poles shall be hot-dip galvanized in accordance with ASTM A 123 and shall not be painted. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor bolt-mounted type.

2.11.3 NOT USED

2.11.4 NOT USED

2.11.5 NOT USED

2.11.6 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.12 NOT USED

2.13 NOT USED

## 2.14 ELECTRICAL ENCLOSURES

The Contractor shall provide metallic enclosures as needed to house the lighting equipment. Enclosures shall conform to NEMA ICS 6 and NEMA 250. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer. The enclosures shall be as specified or as shown on the drawings.

### 2.14.1 Interior Enclosures

Enclosures to house lighting equipment in an interior environment shall meet the requirements of a NEMA 12 enclosure as defined in NEMA 250.

### 2.14.2 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

### 2.14.3 NOT USED

### 2.14.4 Hazardous Environment Enclosures

Equipment installed in a hazardous environment shall be installed as described in paragraph Hazardous Locations.

## 2.15 ILLUMINATION

### 2.15.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area lighting shall be in accordance with the details.

## 2.16 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

### 2.16.1 NOT USED

### 2.16.2 NOT USED

### 2.16.3 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4 or UL 1029.

### 2.17 NOT USED

### 2.18 NOT USED

## 2.19 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

## 2.20 LIGHTING CONTROL EQUIPMENT

Furnish and install a complete lighting control system. System shall include 6, Class 2, 20 amp single pole and 6 Class 2, 20 amp double pole contactors. Exact quantities and equipment configuration as shown on plans.

### 2.20.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control

element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 0.5 to 5.0 foot-candles. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

#### 2.20.2 Timer Control Switches

Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between 2030 hours and 0230 hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise shall be provided. A switch rated 120 volts, having automatically wound spring mechanism to maintain accurate time for a minimum of 7 hours following a power failure shall be provided. A time switch with a manual on-off bypass switch shall be provided. Housing for the time switch shall be a surface mounted, NEMA 1 (indoor) enclosure conforming to NEMA ICS 6.

#### 2.20.3 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

#### 2.20.4 Relays

##### 2.20.4.1 Class 2 Lighting Relays

The Class 2 lighting relays control either 120 or 208 Vac circuits loaded to a maximum of 20 amps. When required, the relays in addition to the Class 2 switching leads, will be equipped with a set of N.O. auxiliary contacts which work in tandem with the high voltage contacts and be used as mechanisms for status feed back or pilot light indicators. Each Class 2 relay may be either a combination Class 2 transformer and magnetic latching relay or split coil latching relay powered from a central transformer. Electrically held relays are not acceptable.

##### 2.20.4.2 [Enter Appropriate Subpart Title Here]

The Class 2 relays are to be mounted in a NEMA enclosure with a factory pre-wired terminal strip or factory remote mounted in minimum 4" x 4" junction box that is accessible. Manufacturer to provide all interface modules (IFM) pilot light transformers (PLPS) pre-wired as required to provide a complete operating system.

##### 2.20.4.3 [Enter Appropriate Subpart Title Here]

Control system shall interface with time clock via dry contact closure. Relays to be remote mounted inside j-box or enclosure located inside pole base. Number of circuits as shown on plans.

#### 2.20.5 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 208 volts, single, 60 Hz. Coil voltage shall be 208 volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

## 2.21 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

## 2.22 LUMINAIRES, FLOODLIGHTING

### 2.22.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572. Incandescent lighting fixtures shall conform to UL 1571.

## 2.23 FIXTURES

Standard fixtures shall be as detailed. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

### 2.23.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

### 2.23.2 NOT USED

### 2.23.3 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated at 30 amperes, 600 volts, with insulated boots. Fuse rating shall be 600 volts.

## PART 3 EXECUTION

### 3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

### 3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

### 3.3 PREVENTION OF CORROSION

#### 3.3.1 NOT USED

#### 3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 0.010 inch thick

pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

### 3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 NOT USED

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 NOT USED

3.10 NOT USED

### 3.11 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of 30 feet. Luminaire mounting height may be increased by the height of the transformer base where required. Electrical cabling shall be provided to the light pole. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

#### 3.11.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. When security lights are used along roadways, brackets shall correctly position roadway luminaires. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

#### 3.11.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 3000 psi at 28 days.

#### 3.11.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided at all poles. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 10 feet above grade. Rigid steel conduit ells shall be provided for wood poles, where required

3.11.4 NOT USED

### 3.11.5 Steel Pole Installation

Poles shall be mounted on cast-in-place or power-installed screw foundations. Conduit elbows shall be provided for cable entrances into pole interiors.

### 3.12 LIGHTING

#### 3.12.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

#### 3.12.2 Fixture Installation

##### 3.12.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

##### 3.12.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

### 3.13 NOT USED

### 3.14 LIGHTING CONTROL SYSTEM

#### 3.14.1 Photo-Control

Lighting luminaires shall be controlled in banks by a single photo-control element mounted within each bank.

#### 3.14.2 Time Control Switches

Switches shall be installed with not less than four 1/4 inch bolts. The use of sheet metal screws will not be allowed.

#### 3.14.3 NOT USED

#### 3.14.4 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws will not be allowed.

### 3.15 NOT USED

### 3.16 TESTS

#### 3.16.1 NOT USED

#### 3.16.2 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

-- End of Section --

SECTION 16710  
PREMISES DISTRIBUTION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA-568-B	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607	(1994) Commercial Building Grounding and Bonding Requirements for Telecommunications
EIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems

IBM PUBLICATION CORPORATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
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INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata) National Electrical Code
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UNDERWRITERS LABORATORY (UL)

UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment
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## 1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

## 1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

## 1.4 QUALIFICATIONS

## 1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

- a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.
- b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.
- c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

#### 1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Premises Distribution System; GA.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Record Drawings; GA.

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

##### SD-06 Instructions

Manufacturer's Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material

being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

#### SD-08 Statements

Test Plan; GA.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; GA.

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

#### SD-18 Records

Record Keeping and Documentation; GA.

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606.

### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

### 1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

### 2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

#### 2.2.1 Cable Insulation

For each individual Category 5 cable, the insulation, material used on each pair shall be exactly the same in all physical, electrical, and chemical respects. The use of Teflon insulated, plenum rated Category 5 cable is acceptable for both plenum and non-plenum applications. If Teflon insulated plenum rated cable is used by the Contractor, it shall be Type 4x0, where all four pairs are Teflon insulated. Type 3x1 and 2x2 are not acceptable.

#### 2.2.2 Riser Cable

Riser cable shall meet the requirements of ICEA S-80-576 and EIA ANSI/TIA/EIA-568-B for Category 5 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG.

#### 2.2.3 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B for Category 5 horizontal cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG.

#### 2.2.4 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with and EIA ANSI/TIA/EIA-568-B.

##### 2.2.4.1 Telecommunications Outlets

Wall and desk outlet plates shall come equipped with two RJ-45 jacks, with the top or left jack labeled "voice" and the bottom or right jack labeled "data". Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-A. Modular jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-A. Faceplates shall be provided and shall be stainless steel. Mounting plates shall be provided for system furniture and shall match the system furniture in color.

##### 2.2.4.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on 19 inch rack mounted or wall mounted panels. Jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-A. Panels shall be provided with labeling space.

##### 2.2.4.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring per EIA ANSI/TIA/EIA-568-B. Patch cords shall be factory assembled.

##### 2.2.4.4 Terminal Blocks

Terminal blocks shall be wall mounted or rack mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA ANSI/TIA/EIA-568-B for category 5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.3 NOT USED

2.4 NOT USED

## 2.5 NOT USED

## 2.6 EQUIPMENT RACKS

### 2.6.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be welded steel relay racks with uprights to mount equipment 19 inches wide. Uprights shall be 3 inch deep channel, 1-1/4 inches wide, drilled and tapped 12-24 in a 1/2 inch pattern.

Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 7 feet in height and clear coated. AC outlets shall be provided as shown.

### 2.6.2 Wall Mounted Open Frame

Wall mounted open frame equipment racks shall be steel relay racks to mount equipment 19 inches wide with standoff brackets for wall mounting.

Uprights shall be drilled and tapped 12-24 in a 1/2 inch pattern. Standoff brackets shall be of sufficient length for a 6 inch clearance between rack and wall. Wall mounted open frame racks shall be hinged. AC outlets shall be provided as shown.

### 2.6.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

### 2.6.4 NOT USED

### 2.6.5 Wall Mounted Cabinets

Wall mounted cabinets shall conform to UL 50 and have boxes constructed of zinc-coated sheet steel with dimensions not less than shown on drawings. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum openings to the box interiors. Boxes shall be provided with 3/4 inch plywood backboard painted white or a light color. A duplex AC outlet shall be installed within the cabinet.

## 2.7 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored paint.

## 2.8 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Provide a minimum 1 inch conduit.

## PART 3 EXECUTION

### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07270 FIRESTOPPING. Conduits, outlets and raceways shall be installed in

accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-B and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

### 3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Copper cable not in a wireway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

### 3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

### 3.1.3 Telecommunications Outlets

#### 3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

#### 3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 6 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

#### 3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

### 3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

### 3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

### 3.1.6 NOT USED

### 3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

### 3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

## 3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

### 3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

## 3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607 and Section 16415 ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

## 3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 10 of each type outlet.
- b. 10 of each type cover plate.
- c. 1 of each type terminal block for each telecommunications closet.
- d. 4 Patch cords of 10 feet for each telecommunications closet.
- e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

## 3.5 ADMINISTRATION AND LABELING

### 3.5.1 Labeling

### 3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606.

### 3.5.1.2 Cable

All cables will be labeled using color labels on both ends with [encoded] [unencoded] identifiers per EIA ANSI/TIA/EIA-606.

### 3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels per EIA ANSI/TIA/EIA-606.

## 3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

### 3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

### 3.6.2 Category 5 Circuits

All category 5 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67 standard. Testing shall use the Basic Link Test procedure of EIA TSB 67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

### 3.6.3 Shielded Twisted Pair

Wiring configuration shall be tested for continuity, opens, shorts, swaps and correct pin configuration; dc resistance both pair-to-pair and wire-to-shield shall be verified. Cable lengths shall be verified. Near end crosstalk shall be tested from 772 kHz to 300 MHz. Ground potential difference between wiring closets, ground potential difference between patch panel and wall outlet, and ground path resistance shall be tested per IBM GA27-3361-07.

-- End of Section --

## SECTION 16711

## TELEPHONE SYSTEM, OUTSIDE PLANT

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.61 (1993) Gas Tube Surge Arrestors on Wire Line Telephone Circuits

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2239 (1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA-607 (1994) Commercial Building Grounding and Bonding Requirements for Telecommunications

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

## INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA ANSI/ICEA S-85-625 (1996) Airecore, Polyolefin Insulated, Copper Conductor Telecommunications Cable

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

## RURAL UTILITIES SERVICE (RUS)

RUS Bulletin 1753F-401(PC-2) (1995) RUS Standard for Splicing Copper and Fiber Optic Cables

RUS Bulletin 1755.910 RUS Specification for Outside Plant Housings and Serving Area Interface Systems

RUS REA Bulletin 345-151 (1989) Specifications and Drawings for Conduit and Manhole Construction (Form 515c)

RUS REA Bulletin 1751F-641 (1995) Construction of Buried Plant

RUS REA Bulletin 1755I-100 (1991; Rev through Supple 11 Nov 92) List of Materials Acceptable for Use on Telephone System of REA Telephone Borrowers

RUS REA PC-4 (1976) Acceptance Tests and Measurements of Telephone Plant

RUS REA PE-33	(1985) Shield Bonding Connectors
RUS REA PE-39	(1993) REA Specification for Filled Telephone Cables
RUS REA PE-89	(1993) Filled Telephone Cables with Expanded Insulation
RUS REA TE&CM 635-03	(1988; Addenda 1 through 4) Construction of Aerial Cable Plant
RUS REA TE&CM 643-02	(1983) Underground Conduit and Manhole Design and Construction (Physical Plant)

#### UNDERWRITERS LABORATORIES (UL)

UL 497	(1995; Rev Mar 1996) Protectors for Paired Conductor Communication Circuits
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### 1.2 SYSTEM DESCRIPTION

The outside plant system shall consist of all cable, conduit, manholes, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, terminating cables, lightning and surge protection modules at the entry facility. The work consists of furnishing, installing, testing and making operational a complete outside plant system for continuous use.

### 1.3 QUALIFICATIONS

#### 1.3.1 Cable Installers

Installation shall be under the direct supervision of an individual with a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

#### 1.3.2 Cable Splicing and Termination

All cable splicers shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

#### 1.3.3 Manufacturers

The cable, equipment, and hardware provided shall be from manufacturers that have a minimum of 3 years experience in producing the types of cable, equipment, and hardware specified.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Telephone System; GA.

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, and catalog cuts. Detail drawings shall also contain complete configuration information, wiring diagrams and any other details

required to demonstrate that the cable system has been coordinated to support the transmission systems identified in the specifications and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations.

Record Drawings; GA.

Record drawings for the installed wiring system showing the actual location of all cable terminations, splices, routing, and size and type of all cables. The identifier for each termination and cable shall appear on the drawings. The drawings shall include gauge and pair or fiber count for each cable, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector block layout at the termination points after installation.

#### SD-06 Instructions

Installation; GA.

Printed copies of the manufacturer's recommendations for the material being installed, prior to installation. Installation of the item will not be allowed to proceed where installation procedures, or any part thereof, are required to be in accordance with those recommendations until the recommendations are received and approved.

#### SD-08 Statements

Acceptance Tests; GA.

Test plans defining all tests required to ensure that the system meets specified requirements. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

Cutover and Records; GA.

The cutover plan shall provide procedures and schedules for relocation of facility station numbers without interrupting service to any active location.

Qualifications; GA.

The qualifications of the manufacturer, splicer, and installation supervisor as specified.

### 1.5 DELIVERY AND STORAGE

#### 1.5.1 Cable Requirements-

All cable shall be shipped on reels. The diameter of the drum shall be large enough to prevent damage to the cable during reeling and unreeling. The reels shall be constructed to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, with sufficient length to make it available for testing. The inner end shall be fastened to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 to plus 148 degrees F, with relative humidity from 0 to 100 percent.

#### 1.5.2 Equipment

All equipment shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants, in accordance with the manufacturer's requirements.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with outside plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer.

### 2.2 CABLE

#### 2.2.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

##### 2.2.1.1 Aerial

- a. Lashed: RUS REA PE-89.
- b. Self Supporting: ICEA ANSI/ICEA S-85-625.

##### 2.2.1.2 NOT USED

##### 2.2.1.3 Underground

Cable shall be manufactured per RUS REA PE-39 or RUS REA PE-89. A 5 mil copper clad alloy steel or 5 mil copper clad stainless steel metallic shield shall be provided.

##### 2.2.1.4 Screened

Screened cable shall comply with RUS REA PE-39 or RUS REA PE-89.

### 2.3 CLOSURES

#### 2.3.1 Copper Conductor Closures

##### 2.3.1.1 Aerial Closure

The aerial closure shall be free breathing and suitable for housing straight and butt splices of non-pressurized communications cables. The closure shall be constructed with ultraviolet resistant PVC.

### 2.4 CABLE SPLICES AND ORGANIZERS

#### 2.4.1 Copper Cable Splices

All cables greater than 25 pairs shall be spliced using modular splicing connectors, which accommodate 25 pairs of conductors at a time. The correct connector size shall be used to accommodate the wire gauge of the cable to be spliced. The connectors used shall be listed in RUS REA Bulletin 1755I-100.

### 2.5 CABLE TERMINALS

#### 2.5.1 Pedestal-Type Cable Terminals

Pedestal-type cable terminals shall conform to RUS Bulletin 1755.910.

#### 2.5.2 Cross-connect Cable Terminals

Cross-connect cable terminals shall be weatherproofed for outdoor use and suitable for pole, pad, or stake mounting. The terminal shall be equipped with mounting columns and distribution rings for jumper-wire routing. The terminal shall be of aluminum or steel construction and ribbed for strength.

#### 2.6 MANHOLE AND DUCT

All manhole and duct products shall conform to RUS REA TE&CM 643-02.

##### 2.6.1 New Manholes

New manholes shall be equipped with pulling-in irons, cable racks, and ground rod, and conform to the requirements of RUS REA Bulletin 345-151. Manholes shall be designed so that the main trunk conduits enter and exit near the center of the ends, and lateral conduits exit on the sides near the corners. Manholes may be pre-cast or cast in place.

##### 2.6.2 NOT USED

##### 2.6.3 Duct/Conduit

Conduit shall be furnished as specified in Sections 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on project drawings.

##### 2.6.4 Innerduct

Innerduct shall be SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

##### 2.7 NOT USED

##### 2.8 NOT USED

#### 2.9 PROTECTOR MODULES

The protector modules shall be of the two-element gas tube type. Protection modules shall be heavy duty, A>10 kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current per ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, be equipped with an external spark gap and heat coils, and shall comply with UL 497.

##### 2.10 NOT USED

#### 2.11 MISCELLANEOUS ITEMS

##### 2.11.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with RUS REA PE-33.

##### 2.11.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

### 2.11.3 Warning Tape

Marking and locating tape shall be acid and alkali resistant polyethylene film, 6 inches wide with a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion and shall be specifically manufactured for marking and locating underground utilities. The warning tape shall be orange in color and continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 48 inch intervals.

### 2.11.4 Cable Warning Signs

Cable warning signs, which identify the route of buried cable, shall be stake mounted. The stake shall be driven into undisturbed soil and the sign shall be mounted to the stake in accordance with the manufacturer's instructions. Warning signs shall be placed at intervals of no more than 500 feet and at each change of direction in the cable route. Warning signs shall also be placed on each side of every crossing of surface obstacles such as roads, railroads, stream crossings, or any similar crossing where excavation is likely to occur.

## PART 3 EXECUTION

### 3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All installation work shall be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and NFPA 70.

#### 3.1.1 Cable Inspection and Repair

All cable and wire used in the construction of the project shall be handled with care. Each reel shall be inspected for cuts, nicks or other damage. All damage shall be repaired to the satisfaction of the Contracting Officer. The reel wrap shall remain intact on the reel until the cable or wire is ready to be placed.

#### 3.1.2 NOT USED

#### 3.1.3 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in RUS REA Bulletin 1751F-641.

##### 3.1.3.1 Cable Pulling

For cable installed in ducts and conduit, a cable feeder guide shall be used, between the cable reel and the face of the duct and conduit, to protect the cable and guide it into the duct and conduit as it is paid off the reel. As the cable is paid off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is paid off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not

cause the cable to be twisted or stretched.

#### 3.1.3.2 Penetrations for Cable Access

Penetrations in walls, ceilings or other parts of the building, made to provide for cable access, shall be caulked and sealed. Where conduits and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in section 07270 FIRE STOPPING. Fire stopped penetrations shall not compromise the fire rating of the walls or floors. All underground building entries shall be through waterproof facilities.

#### 3.1.3.3 Cable Bends

Telephone cable bends shall have a radius of not less than 10 times the cable diameter. Only large radius sweeps shall be used in conduit runs and shall not exceed a cumulative 90 degrees between manholes.

#### 3.1.4 Aerial Cable

Aerial cable installation shall be accomplished in accordance with the requirements set forth in RUS REA TE&CM 635-03.

#### 3.1.5 Manhole and Ducts

Manhole and duct systems shall be installed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Manholes shall be placed in line with the main duct. Splice cases shall be mounted in the center on the long sides. Lateral conduits shall exit the long sides near the corners.

##### 3.1.5.1 Innerduct Installation

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be plugged at both ends with polyurethane foam duct seal; this material shall also be inserted between the innerduct and the duct if cables are placed in the innerducts. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 2 inches exposed.

##### 3.1.5.2 Pull Cord

Pull cords of 3/8 inch polypropylene shall be installed in all unused ducts and inner-ducts with a minimum of 2 feet spare cord protruding from each end.

### 3.2 SPLICING

#### 3.2.1 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with RUS Bulletin 1753F-401(PC-2). Modular splicing shall be used on all cables larger than 25 pairs.

#### 3.2.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with the manufacturer's recommendation; each splice shall have a loss of less than 0.1 dB.

### 3.3 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable

splices, and terminals shall be grounded. Grounding shall be in accordance with requirements of NFPA 70, Articles 800-33 and 800-40.

### 3.3.1 Ground Bars

#### 3.3.1.1 Telecommunications Master Ground Bar (TMGB)

A copper TMGB shall be provided, in accordance with EIA ANSI/TIA/EIA-607, to be the hub of the basic grounding system by providing a common point of connection for ground from outside cable, MDF, and equipment. The TMGB shall have a ground resistance, including ground, of 10 ohms or less.

#### 3.3.1.2 Telecommunications Ground Bar (TGB)

Copper TGB shall be provided in accordance with EIA ANSI/TIA/EIA-607 in each communications closet and room and each frame. The TGB shall be connected to the TMGB in accordance with EIA ANSI/TIA/EIA-607. Each TGB shall be connected to the TMGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 ohms.

### 3.3.2 Incoming Outside Plant Cables

All incoming outside plant cable shields shall be bonded directly to the TMGB or the closest TGB.

### 3.3.3 Cable Stubs

All shields of cable stubs shall be bonded to a TGB located on the frame.

### 3.3.4 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs.

### 3.3.5 Protection Assemblies

The protector assemblies shall be mounted directly on the vertical frame ironwork. The assemblies mounted on each vertical frame shall be connected with a No. 6 AWG copper conductor to provide a low resistance path to the TGB.

### 3.3.6 Manholes

The shields of all cables in each manhole shall be bonded together by a bonding wire or ribbon. At intermediate manholes, where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of spliced cables shall be attached to it.

## 3.4 CUTOVER AND RECORDS

All necessary transfers and cutovers, shall be accomplished by the Contractor.

## 3.5 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test; testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans

shall identify the capabilities and functions to be tested.

### 3.5.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with RUS REA PC-4:

- a. Shield continuity.
- b. Conductor continuity.
- c. Conductor insulation resistance.
- d. Structural return loss.
- e. Cable insertion loss and loss margin at carrier frequencies.
- f. Shield ground for single jacketed cables.
- g. DC loop resistance.

-- End of Section --

## SECTION 16751

## CLOSED CIRCUIT TELEVISION SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

## DEPARTMENT OF DEFENSE (DOD)

DOD 3235.1 (Rev H) Test & Evaluation of System  
Reliability Availability and  
Maintainability - A Primer

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 170 (1957) Electrical Performance Standards -  
Monochrome Television Studio Facilities

EIA ANSI/EIA/TIA-232-E (1991) Interface Between Data Terminal  
Equipment and Data Circuit-Terminating  
Equipment Employing Serial Binary Data  
Interchange

EIA ANSI/EIA-310-D (1992) Cabinets, Racks, Panels, and  
Associated Equipment

EIA ANSI/EIA-330 (1968) Electrical Performance Standards  
for Closed Circuit Television Camera  
525/60 Interlaced 2:1

EIA ANSI/EIA-375-A-1976 (1974) Electrical Performance Standards  
for Direct View Monochrome Closed Circuit  
Television Monitors 525/60 Interlaced 2:1

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC  
Power Circuits

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

## UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 1410 (1997) Television Receivers and  
High-Voltage Video Products

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General

The Contractor shall configure the system as described and shown. All television equipment shall conform to EIA 170 specifications. The system shall include all connectors, adapters, and terminators necessary to interconnect all equipment. The Contractor shall also supply all cabling necessary to interconnect the closed circuit television (CCTV) equipment installed in the Security Center, and interconnect equipment installed at remote control/monitoring stations.

### 1.2.2 System Overall Reliability Requirement

The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF) of at least 5000 hours, and shall be calculated based on the configuration specified in paragraph "System Overall Reliability Calculations."

### 1.2.3 Power Line Surge Protection

All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

### 1.2.4 Video and Sync Signal Transmission Line Surge Protection

All cable, except fiber optic cable, used for sync or video signal transmission shall include protective devices to safeguard the CCTV equipment against surges. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. The surge suppression device shall be capable of dissipating not less than 1500 watts for 1 millisecond, and the response time from zero volts to clamping shall not be greater than 5 nanoseconds. Fuses shall not be used for surge protection.

### 1.2.5 Control Line Surge Protection

All cables and conductors, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against surges and shall have surge protection installed at each end. Protection shall be furnished at the equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

### 1.2.6 Power Line Conditioners

A power line conditioner shall be furnished for the security console CCTV equipment. The power line conditioner shall be of the ferroresonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The power line conditioner shall be sized for 125 percent of the actual connected kVA load. Characteristics of the power line conditioner shall be as follows:

- a. At 85 percent load, the output voltage shall not deviate by more

than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

- b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.
- c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

#### 1.2.7 Video and Control Signal Data Transmission Media

The Contractor shall provide a video and data and control signal transmission system as specified in Section 16768.

#### 1.2.8 Environmental Conditions

##### 1.2.8.1 Field Equipment

The cameras and all other field equipment shall be rated for continuous operation under ambient environmental conditions of 14 degrees to 120 degrees F using no auxiliary heating or cooling equipment. Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, wind loading, ice loading, and vibration conditions specified or encountered for the installed location.

##### 1.2.8.2 Security Center Equipment

Security Center and remote control/monitoring station equipment shall, unless designated otherwise, be rated for continuous operation under ambient environmental conditions of 60 degrees F to 85 degrees F and a relative humidity of 20 to 80 percent.

#### 1.2.9 Electrical Requirements

Electrically powered IDS equipment shall operate on 120 volt 60 Hz AC sources as shown. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

All electrical and electronic equipment in the console shall be powered from an UPS. The UPS shall provide 4 hours battery back-up in the event of primary failure. Batteries shall be sealed non-outgassing type.

#### 1.3 DELIVERY OF TECHNICAL DATA AND COMPUTER SOFTWARE

All items of computer software and technical data (including technical data which relates to computer software), which are specifically identified in this specification shall be delivered strictly in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, Section 01330 SUBMITTAL PROCEDURES, and in accordance with the Contract Data Requirements List (CDRL), DD Form 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. If the CCTV system is being installed in conjunction with an IDS or EECS the CCTV Technical Data Packages shall be submitted as part of the Technical Data Packages for Section 16725 INTRUSION DETECTION SYSTEMS, or Section 16752 ELECTRONIC ENTRY CONTROL SYSTEMS.

##### 1.3.1 Group I Technical Data Package

###### 1.3.1.1 System Drawings

The data package shall include the following:

- a. System block diagram.
- b. CCTV system console installation, block diagrams, and wiring diagrams.
- c. Security center CCTV equipment installation, interconnection with console equipment, block diagrams and wiring diagrams.
- d. Remote control/monitoring station installation, interconnection to security center including block diagrams and wiring diagrams.
- e. Camera wiring and installation drawings.
- f. Pan/tilt mount wiring and installation drawings.
- g. Interconnection with video signal transmission system, block diagrams and wiring diagrams.
- h. Surge protection device installation.

#### 1.3.1.2 Manufacturers' Data

The data package shall include manufacturers' data for all materials and equipment and security center equipment provided under this specification.

#### 1.3.1.3 System Description and Analyses

The data package shall include complete system descriptions, analyses and calculations used in sizing the equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance of this specification. The data package shall include the following:

- a. Switcher matrix size.
- b. Camera call-up response time.
- c. System start up and shutdown operations.
- d. Switcher programming instructions.
- e. Switcher operating and maintenance instructions.
- f. Manuals for CCTV equipment.
- g. Data entry forms.

#### 1.3.1.4 Software Data

The data package shall consist of descriptions of the operation and capability of system and application software as specified.

#### 1.3.1.5 Overall System Reliability Calculations

The data package shall include all manufacturer's reliability data and calculations required to show compliance with the specified reliability. The reliability data shall be prepared using DOD 3235.1 as a guide. The calculations shall be based on all CCTV equipment associated with one camera circuit and the console CCTV equipment, excluding the data transmission media (DTM).

#### 1.3.1.6 Certifications

All specified manufacturer's certifications shall be included with the data package.

#### 1.3.2 Group II Technical Data Package

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall submit a report to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. For those changes or conditions which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct any deficiency without written permission from the Government.

#### 1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the predelivery test. The Contractor shall deliver the predelivery test procedures to the Government for approval. After receipt by the Contractor of written approval of the predelivery test procedures, the Contractor may schedule the predelivery test. The final predelivery test report shall be delivered after completion of the predelivery test.

#### 1.3.4 Group IV Technical Data Package

The Contractor shall prepare test procedures and reports for the performance verification test and the endurance test. The Contractor shall deliver the performance verification test and endurance test procedures to the Government for approval. After receipt by the Contractor of written approval of the test procedures, the Contractor may schedule the tests. The contractor shall provide a report detailing the results of the field test and a video tape as specified in paragraph "Contractor's Field Testing." The final performance verification and endurance test report shall be delivered after completion of the tests.

##### 1.3.4.1 Operation and Maintenance Manuals

A draft copy of the operation and maintenance manuals, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

##### 1.3.4.2 Training Documentation

Lesson plans and training manuals for the training phases, including type of training to be provided with a sample training report, and a list of reference material, shall be delivered for approval.

##### 1.3.4.3 Data Entry

The Contractor shall enter all data needed to make the system operational. The Contractor shall deliver the data to the Government on data entry forms, utilizing data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession required for complete installation of the data base. The Contractor shall identify and request from the Government, any additional data needed to provide a complete and operational CCTV system. The completed forms shall be delivered to the Government for review and approval at least 90 days prior to the Contractor's scheduled need date.

#### 1.3.5 Group V Technical Data Package

Final copies of the manuals as specified bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the

manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance.

#### 1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

#### 1.3.5.2 Hardware Manual

A manual shall describe all equipment furnished, including:

- a. General hardware description and specifications.
- b. Installation and checkout procedures.
- c. Equipment electrical schematics and layout drawings.
- d. System schematics and wiring lists.
- e. System setup procedures.
- f. Manufacturer's repair parts list indicating sources of supply.
- g. Interface definition.

#### 1.3.5.3 Software Manual

The software manual shall describe the functions of all software, and shall include all other information necessary to enable proper loading, testing and operation, including:

- a. Definitions of terms and functions.
- b. Procedures for system generation.
- c. Description of implementation of the program.
- d. Description of required sequences.
- e. Directory of all disk files.
- f. Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer.

#### 1.3.5.4 Operator's Manual

The operator's manual shall explain all procedures and instructions for operation of the system including:

- a. Video switcher.
- b. Cameras and video recording equipment.

- c. Use of the software.
- d. Operator commands.
- e. System start-up and shut-down procedures.
- f. Recovery and restart procedures.

#### 1.3.5.5 Maintenance Manual

The maintenance manual shall describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

#### 1.3.5.6 Final System Drawings

The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the CCTV system to be used for final system drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the CCTV system and shall be delivered to the Government with the final endurance test report. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the final system drawings, a representative of the Government will review the final system work with the Contractor. If the final system work is not complete, the Contractor will be so advised and shall complete the work as required. Final drawings submitted with the endurance test report shall be finished drawings on mylar or vellum.

### 1.4 TESTING

#### 1.4.1 General

The Contractor shall perform predelivery testing, site testing, and adjustment of the completed CCTV system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific test procedures.

#### 1.4.2 Test Procedures and Reports

Test procedures shall explain, in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

### 1.5 TRAINING

#### 1.5.1 General

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the CCTV system as specified. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be delivered for each trainee with two additional manuals delivered for archiving at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor is responsible for furnishing all audio-visual equipment and all other training materials and supplies. Where the Contractor presents portions of the course through the use of audio-visual material, copies of the audio-visual materials shall be delivered to the Government, either as a part of the printed training manuals or on the same media as that used during the training sessions. A training day is 8 hours of instruction,

including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the facility. For guidance in planning the required instruction, the Contractor should assume the attendees will have a high school education or equivalent. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

#### 1.5.2 Operator's Training

The course shall be taught at the project site for five consecutive training days during or after the Contractor's field testing. A maximum of 12 personnel will attend the course. No part of the training given during this course will be counted toward completion of the performance verification test. The course shall consist of classroom instruction, hands-on training, instruction on the specific hardware configuration of the installed system, and specific instructions for operating the installed system. The course shall demonstrate system start up, system operation, system shutdown, system recovery after a failure, the specific hardware configuration, and operation of the system and its software. The students should have no unanswered questions regarding operation of the installed CCTV system. The Contractor shall prepare and insert additional training material in the training manuals when the need for additional material becomes apparent during instruction. The Contractor shall prepare a written report after the completion of the course. The Contractor shall list in the report the times, dates, attendees and material covered at each training session. The Contractor shall describe the skill level of each student at the end of this course. The Contractor shall submit the report before the end of the performance verification test. The course shall include:

- a. General CCTV hardware, installed system architecture and configuration.
- b. Functional operation of the installed system and software.
- c. Operator commands.
- d. Alarm interfaces.
- e. Alarm reporting.
- f. Fault diagnostics and correction.
- g. General system maintenance.
- h. Replacement of failed components and integration of replacement components into the operating CCTV system.

#### 1.6 MAINTENANCE AND SERVICE

##### 1.6.1 General Requirements

The Contractor shall provide all services required and equipment necessary to maintain the entire CCTV system in an operational state as specified for a period of 1 year after completion of the endurance test, and shall provide all necessary material required for the work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other unscheduled work.

##### 1.6.2 Description of Work

The adjustment and repair of the CCTV system includes all computer equipment, software updates, signal transmission equipment, and video equipment. Provide the manufacturer's required adjustments and all other work necessary.

### 1.6.3 Personnel

Service personnel shall be qualified to accomplish all work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

### 1.6.4 Schedule of Work

The Contractor shall perform two inspections at 6-month intervals or less. This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. These inspections shall include:

- a. Visual checks and operational tests of the CPU, switcher, peripheral equipment, interface panels, recording devices, monitors, video equipment electrical and mechanical controls, and a check of the picture quality from each camera.
- b. Run system software and correct all diagnosed problems.
- c. Resolve any previous outstanding problems.

### 1.6.5 Emergency Service

The Government will initiate service calls when the CCTV system is not functioning properly. Qualified personnel shall be available to provide service to the complete CCTV system. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 24 hours after receiving a request for service. The CCTV system shall be restored to proper operating condition within 3 calendar days after receiving a request for service.

### 1.6.6 Operation

Performance of scheduled adjustments and repair shall verify operation of the CCTV system as demonstrated by the applicable portions of the performance verification test.

### 1.6.7 Records and Logs

The Contractor shall keep records and logs of each task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain calibration, repair, and programming data. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the CCTV system.

### 1.6.8 Work Requests

The Contractor shall separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within 5 days after work is completed.

### 1.6.9 System Modifications

The Contractor shall make any recommendations for system modification in writing to the Government. No system modifications, including operating parameters and control settings, shall be made without prior approval of

the Government. Any modifications made to the systems shall be incorporated into the operations and maintenance manuals, and other documentation affected.

#### 1.6.10 Software

The Contractor shall recommend all software updates to the Government for approval. Upon Government approval, updates shall be accomplished in a timely manner, fully coordinated with the CCTV system operators, operation in the system verified, and shall be incorporated into the operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the manufacturer's software.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

All system hardware and software components shall be produced by manufacturers regularly engaged in the production of CCTV equipment. Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Equipment located at the security center or a remote control/monitoring station shall be rack mounted as shown. Television equipment shall comply with 47 CFR 15, Subparts C and H. Computing devices shall comply with 47 CFR 15, Subpart J.

##### 2.1.1 NOT USED

##### 2.1.2 Soldering

All soldering shall be done in accordance with standard industry practices.

#### 2.2 ENCLOSURES

The Contractor shall provide metallic enclosures as needed for equipment not housed in racks or supplied with a housing. The enclosures shall be as specified or shown.

##### 2.2.1 Interior

Enclosures to house equipment in an interior environment shall meet the requirements of NEMA 250 Type 12.

##### 2.2.2 Exposed-to-Weather

Enclosures to house equipment in an outdoor environment shall meet the requirements of NEMA 250 Type 4X.

##### 2.2.3 Interior Equipment Rack

Rack kits are designed to convert desktop equipment to rack mount units for use in standard 19-inch EIA racks or consoles. All rack kits have a black polyester powder coat finish to match the exterior finish of the equipment.

#### 2.3 NOT USED

#### 2.4 LOCKS AND KEY-LOCK OPERATED SWITCHES

##### 2.4.1 Locks

All locks required to be installed on system enclosures for maintenance purposes shall be UL listed, round-key type, with three dual, one mushroom,

and three plain pin tumblers or conventional key type lock having a combination of five cylinder pin and five-point three position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." The locks shall be so arranged that the key can only be withdrawn when in the locked position. All maintenance locks shall be keyed alike and only two keys shall be furnished for all of these locks.

## 2.5 NOT USED

## 2.6 TUBE CAMERA

The video camera shall conform to EIA 170 and EIA ANSI/EIA-330 specifications. All electronic components and circuits shall be solid state except for the imaging tube. Signal-to-noise ratio shall not be less than 43 dB unweighted. Geometric distortion shall not exceed 2 percent in any area of the picture. The lens mount shall be a C-mount, and the camera shall have an externally accessible back focus adjustment. The camera shall operate from 14 to 120 degrees F without auxiliary heating or cooling, and shall not exhibit any change in picture quality or resolution.

The camera shall operate on 60 Hz AC power, and shall be capable of operating over a voltage range of 105 to 130 or 205 to 240 as shown on drawings.

### 2.6.1 Type of Tube

The tube shall be a 1 inch format vidicon image tube, and shall be free of blemishes. The camera shall provide not less than 650 lines of horizontal resolution at the center of the picture, and resolution shall not vary more than 50 lines after 5,000 hours of use.

### 2.6.2 Sensitivity

The Camera shall provide full video without camera automatic gain with a scene reflectivity of 75 percent using an f/1.4 lens giving a camera faceplate illumination at 2850 K of 0.0046 footcandle.

### 2.6.3 Camera Synchronization

The camera shall have an input for external sync, and shall automatically switch over to internal sync if external sync is not present. The camera shall also have the capability of synchronization by line-locking to the AC power 60 Hz line frequency at the zero crossing point, and shall provide not less than plus or minus 90 degrees of vertical phase adjustment.

### 2.6.4 Connectors

Cameras with lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors and wiring as needed to operate the lens functions. Video signal output connector shall be a bayonet connector (BNC). Cameras with integral fiber optic video transmitters shall have straight-tip bayonet type fiber optic video output connectors. A connector shall be provided for external sync input.

### 2.6.5 Automatic Circuits

The camera shall have automatic scan failure protection for both horizontal and vertical drives. The camera shall have automatic beam control, automatic black level, automatic white clipper, automatic gain control, and automatic target voltage limiting circuitry.

## 2.7 NOT USED

## 2.8 CAMERA LENSES

Camera lenses shall be all glass with coated optics. The lens mount shall

be a C-mount. The lens shall be supplied with the camera, and shall have a maximum f-stop opening of f/1.4 or the maximum available for the focal length specified. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lens focal lengths shall be as shown or specified in the lens table.

## 2.9 CAMERA HOUSING

The camera and lens shall be enclosed in a tamper resistant housing as defined in the following specification. Any ancillary housing mounting hardware needed to install the housing at the camera location shall be provided as part of the housing.

### 2.9.1 Environmentally Sealed Camera Housing

The housing shall be designed to provide a condensation free environment for camera operation. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be equipped with supplementary camera mounting blocks or supports as needed for pan/tilt unit mounting centerline. All electrical and signal connections required for operation of the camera, pan/tilt motor, heater, and lens shall be supplied. The housing shall provide the environment needed for camera operation, and shall keep the viewing window free of fog, snow, and ice. The housing shall be equipped with a sunshield, and both the housing and the sunshield shall be white. A mounting bracket which can be adjusted to center the weight of the housing and camera assembly shall be provided as part of the housing. Heater and thermostat shall be provided in housing. Heating strips to be UL listed and constructed from 4-ply fiberglass-supported silicone rubber. Each strip backed with 20 mil aluminum. Thermostat closes at 35 deg. F and opens at 50 deg. F. Supply voltage to match camera, etc.

## 2.10 VIDEO MONITOR

The monitor shall conform to EIA 170, EIA ANSI/EIA-375-A-1976, and UL 1410 specifications. All electronic components and circuits shall be solid state except for the picture tube. The monitor shall operate on 120 volts 60 Hz AC power, shall have a stabilized high voltage power supply, and regulated low voltage power supplies. The monitor shall have automatic frequency control (AFC), bandwidth greater than 7 MHz, and horizontal resolution not less than 700 lines at the center of the picture tube. The monitor shall be capable of reproducing a minimum of 10 discernable shades of gray as described in EIA ANSI/EIA-375-A-1976. The video input shall accept composite video with switchable loop-through or 75 ohm termination.

### 2.10.1 Picture Tube

The monitor shall have a 20 inch picture tube measured diagonally.

### 2.10.2 Configuration

The monitor shall be rack-mounted.

### 2.10.3 Controls

Front panel controls shall be provided for power on/off, horizontal hold, vertical hold, contrast, and brightness. The monitor shall have switchable DC restoration.

### 2.10.4 Connectors for Video Monitor

Video signal input and output shall be by BNC connectors.

## 2.11 VIDEO SWITCHER

The switcher shall conform to EIA 170 specifications, and shall be a vertical interval switcher. Electronic components, subassemblies, and circuits of the switcher shall be solid state. The switcher shall be microprocessor based and software programmable. The switcher shall be a modular system that shall allow for expansion or modification of inputs, outputs, alarm interfaces, and secondary control stations by addition of the appropriate modules. Switcher components shall operate on 120 volts 60 Hz AC power. The switcher central processor unit shall be capable of being interfaced to a master security computer for integrated operation and control. The video switcher central processing unit (CPU) shall have the capability of accepting time from a master clock supplied in ASCII format through an EIA ANSI/EIA/TIA-232-E input. All components, modules, cables, power supplies, software, and other items needed for a complete and operable CCTV switching system shall be provided. Switcher equipment shall be rack mounted unless otherwise specified. Rack mount hardware shall be supplied to mount the switcher components in a standard 19 inch rack as described in EIA ANSI/EIA-310-D.

### 2.11.1 Switcher Software

The switcher shall be software programmable, and the software shall be supplied as part of the switcher. The software shall be installed in the switcher CPU, and shall be configured as required by the site design. Changes or alterations of features under software control shall be accomplished through software programming without changes in hardware or system configuration. The switcher shall retain the current program for at least 4 hours in the event of power loss, and shall not require reprogramming in order to restart the system.

### 2.11.2 Switcher Matrix

The switcher shall be a programmable crosspoint switcher capable of switching any video input to any video output.

### 2.11.3 NOT USED

### 2.11.4 Switcher Response Time and Alarm Processing

The switcher response time shall not be greater than 200 milliseconds from the time the alarm is sensed at the switcher alarm interface, until the picture is displayed on the monitor. The switcher shall continue to process subsequent alarms and shall put them in a queue. The operator shall be able to view the alarms in queue by operating an alarm release function which switches the subsequent alarms to the monitor in the order of occurrence.

### 2.11.5 Control Keyboards

Control and programming keyboards shall be supplied for the video switcher at the security center, and control keyboards shall be supplied for any control/monitoring stations as shown. The control keyboard shall provide the interface between the operator and the CCTV system, and shall relay commands from the operator to the switcher CPU. The keyboard shall provide control of the video switcher functions needed for operation and programming of the video switcher. Controls shall include, but not be limited to: programming the switcher, switcher control, lens function control, pan/tilt/zoom (PTZ) control, control of environmental housing accessories, and annotation programming. If the switcher CPU requires an additional text keyboard for system management functions, the keyboard shall be supplied as part of the video switcher.

#### 2.11.6 Accessory Control Equipment

The video switcher shall be equipped with signal distribution units, preposition cards, expansion units, cables, software or any other equipment needed to ensure that the CCTV system is complete and fully operational.

#### 2.11.7 Connectors for Video Switcher

Video signal input and output shall be by BNC connectors.

#### 2.11.8 Video Annotation

Video annotation equipment shall be provided for the video switcher. The annotation shall be alphanumeric and programmable for each video source. Annotation to be generated shall include, but not be limited to: individual video source identification number, time (hour, minute, second) in a 24 hour format, date (month, day, year), and a unique, user-defined title with at least 8 characters. The annotation shall be inserted onto the source video so that both shall appear on a monitor or recording. The lines of annotation shall be movable for horizontal and vertical placement on the video picture. The annotation shall be automatically adjusted for date. Programmed annotation information shall be retained in memory for at least 4 hours in the event of power loss.

#### 2.12 NOT USED

#### 2.13 NOT USED

#### 2.14 NOT USED

#### 2.15 CAMERA SUPPORT EQUIPMENT

The camera and lens contained in a camera housing shall be installed on a camera support as shown. Any ancillary mounting hardware needed to install the support and to install the camera on the support shall be provided as part of the support. The camera support shall be capable of supporting the equipment to be mounted on it including wind and ice loading normally encountered at the site.

#### 2.16 NOT USED

#### 2.17 WIRE AND CABLE

The Contractor shall provide all wire and cable. All wire and cable components shall be able to withstand the environment the wire or cable is installed in for a minimum of 20 years.

##### 2.17.1 CCTV Equipment Video Signal Wiring

The coaxial cable shall have a characteristic impedance of 75 ohms plus or minus 3 ohms. RG-6 coaxial signal cable shall have shielding which provides a minimum of 95 percent coverage, a solid copper center conductor of not less than 23 AWG, polyethylene insulation, and a black non-contaminating polyvinylchloride (PVC) jacket.

##### 2.17.2 Low Voltage Control Wiring

Twisted pair low voltage control wiring to be used above ground or as direct burial cable shall be provided. Plenum or riser cables shall be IEEE C2 CL2P certified.

##### 2.17.3 Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at

the security center or at a secondary control/monitoring site shall be not less than 20 AWG and shall be stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100 percent coverage. Cables with a single overall shield shall have a tinned copper shield drain wire. Plenum or riser cables shall be IEEE C2 CL2P certified.

#### 2.18 RECEIVER/DRIVER

The receiver/driver operates on the principle of transferring control information and video on the same line. A train of pulses containing control data is superimposed on the vertical blanking interval of the video signal.

Standard features include pan/tilt control, camera power, zoom lens control (zoom, iris, and focus with adjustable speed - speed not remote controllable), and an open collector transistor (latching) output for use in manual override of an automatic iris control.

#### 2.19 WEATHERPROOF POWER SUPPLY

The power supplies provide 24 VAC output for 1-4 cameras. To compensate for voltage losses over long wire runs. The power supplies have a selectable input of 120 or 230 VAC.

The power supplies are capable of handling pan/tilt, heater, and blower operation in addition of the camera.

The power supply is a four-output supply capable of handling up to 20 amps (480 vA) of total load. Power supply is available with fuses on each output. Fuses provide a greater degree of protection for the camera because they are faster acting and more precise.

Enclosure shall be NEMA 4, aluminum, with a gray polyester powder coat.

#### 2.20 COAXIAL SIGNAL AMPLIFIER

Coax amp provides a low cost, highly effective means of maintaining CCTV picture quality in runs of up to 4,500 feet of RG-6 coaxial cable and also maintains the quality of the control signal. Through panel controls provide for adjustable amplifier flat gain of 1-8 dB, plus adjustable high frequency boost of from 0 to greater than 18 dB at 12 MHz, maintaining full video amplitude, contrast and detail.

The Amp features all solid-state circuitry and is supplied with a UL listed wall transformer.

Applications of the EA2000 should be for post-equalization only (located near the monitoring equipment); use as a pre-equalizer is discouraged.

Three units can be racked mounted, or two units can be mounted side-by-side in one chassis.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system. All interior wiring, including low voltage wiring outside the security center control console and equipment racks, cabinets, boxes and similar enclosures, shall be installed in rigid, galvanized steel conduit conforming to UL 6.

Interconnection wiring between components mounted in the same rack or cabinet does not need to be installed in conduits. Minimum conduit size shall be 1/2 inch. Connections shall be tight tapered threaded. No threadless fittings or couplings shall be used. Conduit enclosures shall be cast metal or malleable iron with threaded hubs or bodies. Electric metallic tubing (EMT), armored cable, nonmetallic sheathed cables, or flexible conduit will not be permitted except where specifically shown. DTM shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the CCTV system, except where specifically shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.1.1 NOT USED

3.1.2 NOT USED

3.1.3 Enclosure Penetrations

All enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.1.4 Cold Galvanizing

All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.5 Interconnection of Console Video Equipment

The Contractor shall connect signal paths between video equipment with RG-6 coaxial cable. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.

3.1.6 Cameras

The Contractor shall install the cameras with the proper focal length lens as indicated for each zone; connect power and signal lines to the camera; set cameras with fixed iris lenses to the proper f-stop to give full video level; aim camera to give field of view as needed to cover the alarm zone; aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun; focus the lens to give a sharp picture over the entire field of view; and synchronize all cameras so the picture does not roll on the monitor when cameras are selected.

3.1.7 Monitors

The Contractor shall install the monitors as shown and specified; connect all signal inputs and outputs as shown and specified; terminate video input signals as required; and connect the monitor to AC power.

3.1.8 Switcher

The Contractor shall install the switcher as shown and according to manufacturer's instructions; connect all subassemblies as specified by the

manufacturer and as shown; connect video signal inputs and outputs as shown and specified; terminate video inputs as required; connect alarm signal inputs and outputs as shown and specified; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer and as shown; connect the switcher CPU and switcher subassemblies to AC power; load all software as specified and required for an operational CCTV system configured for the site requirements, including data bases, operational parameters, and system, command, and application programs; provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test; and program the video annotation for each camera.

3.1.9 NOT USED

3.1.10 NOT USED

3.1.11 Camera Mount

The Contractor shall: install the camera mount as specified by the manufacturer and as shown; provide mounting hardware sized appropriately to secure the mount, camera and housing with maximum wind and ice loading encountered at the site; provide electrical and signal transmission cabling to the mount location; connect signal lines and AC power to mount interfaces; connect pole wiring harness to camera.

3.1.12 Pan/Tilt Mount

The Contractor shall install pan/tilt mount, receiver/driver and mount appurtenances as specified by the manufacturer and as shown; supply mounting hardware sized appropriately to secure pan/tilt, camera and housing with maximum wind and ice loading encountered at the site; install pan/tilt control wiring; and connect pan/tilt to control wiring and AC power.

3.2 SYSTEM STARTUP

The Contractor shall not apply power to the CCTV system until the following items have been completed:

- a. CCTV system equipment items and DTM have been set up in accordance with manufacturer's instructions.
- b. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
- c. System wiring has been tested and verified as correctly connected as indicated.
- d. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
- e. Power supplies to be connected to the CCTV system have been verified as the correct voltage, phasing, and frequency as indicated.
- f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 NOT USED

3.4 SITE TESTING

### 3.4.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. The Government will witness all performance verification and endurance testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test.

### 3.4.2 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing.

The report shall also include a copy of the approved performance verification test procedure. In addition, the Contractor shall make a master video tape recording showing typical day and night views of each camera in the system and shall deliver the tape with the report. Note any objects in the field of view that might produce highlights that could cause camera blinding. Note any objects in the field of view or anomalies in the terrain which may cause blind spots. Note if a camera cannot be aimed to cover the zone and exclude the rising or setting sun from the picture. Note night assessment capabilities and whether lights or vehicle headlights cause blooming or picture degradation. If any of the above conditions or other conditions exist that cause picture degradation or interfere with the camera field of view, the Contractor shall inform the Contracting Officer. The tape shall be recorded using the video recorder installed as part of the CCTV system. If a recorder is not part of the CCTV system, the Contractor shall provide the tape in Video Home System (VHS) format. The Contractor shall provide the Government with the original tape as part of the documentation of the system and shall submit a letter certifying that the CCTV system is ready for performance verification testing. The field testing shall as a minimum include:

- a. Verification that the video transmission system and any signal or control cabling have been installed, tested, and approved.
- b. When the system includes remote control/monitoring stations or remote switch panels, verification that the remote devices are functional, communicate with the security center, and perform all functions as specified.
- c. Verification that the switcher is fully functional and that the switcher software has been programmed as needed for the site configuration.
- d. Verification that switcher software is functioning correctly. All software functions shall be exercised.
- e. Operation of all electrical and mechanical switcher controls and verification that the control performs the designed function.
- f. Verification that all video sources and video outputs provide a full bandwidth signal that complies with EIA 170 at all video inputs.
- g. Verification that all video signals are terminated properly.
- h. Verification that all cameras are aimed and focused properly. The Contractor shall conduct a walk test of the area covered by each

camera to verify the field of view.

- i. Verification that cameras facing the direction of rising or setting sun are aimed sufficiently below the horizon so that the camera does not view the sun directly.
- j. If vehicles are used in proximity of the assessment areas, verification of night assessment capabilities and determination if headlights cause blooming or picture degradation.
- k. Verification that all cameras are synchronized and that the picture does not roll when cameras are switched.
- l. When pan/tilt mounts are used in the system, verification that the limit stops have been set correctly. Verification of all controls for pan/tilt or zoom mechanisms are operative and that the controls perform the desired function. If preposition controls are used, verification that all home positions have been set correctly, and have been tested for auto home function and correct home position.

The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

#### 3.4.3 Performance Verification Test

The Contractor shall demonstrate that the completed CCTV system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the Government, based on the Contractor's written report. This shall include certification of successful completion of Contractor Field Testing as specified in paragraph "Contractor's Field Testing," and upon successful completion of training as specified. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

-- End of Section --

## SECTION 16768

## FIBER OPTIC DATA TRANSMISSION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 170	(1957) Electrical Performance Standards - Monochrome Television Studio Facilities
EIA ANSI/TIA/EIA-455-13A	(1996) FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies
EIA ANSI/EIA/TIA-455-25B	(1996) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies
EIA ANSI/EIA/TIA-455-30B	(1991) FOTP-30 Frequency Domain Measurement of Multimode Optical Fiber Information Transmission Capacity
EIA ANSI/TIA/EIA-455-41A	(1993) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables
EIA ANSI/EIA/TIA-455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
EIA ANSI/EIA/TIA-455-47B	(1992) FOTP-47 Output Far Field Radiation Pattern Measurement
EIA ANSI/EIA/TIA-455-58A	(1990) FOTP-58 Core Diameter Measurement of Graded-Index Optical Fibers
EIA ANSI/EIA/TIA-455-59	(1989) FOTP-59 Measurement of Fiber Point Defects Using an OTDR
EIA ANSI/EIA/TIA-455-61	(1989) FOTP-61 Measurement of Fiber or Cable Attenuation Using an OTDR
EIA ANSI/EIA-455-65	(1988) FOTP-65 Optical Fiber Flexure Test
EIA ANSI/EIA-455-81A	(1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA ANSI/EIA/TIA-455-82B	(1992) FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
EIA ANSI/EIA-455-88	(1987) FOTP-88 Fiber Optic Cable Bend Test
EIA ANSI/EIA-455-91	(1986; R 1991) FOTP-91 Fiber Optic Cable Twist-Bend Test

EIA ANSI/TIA/EIA-455-104A	(1993) FOTP-104 Fiber Optic Cable Cyclic Flexing Test
EIA ANSI/EIA/TIA-455-170	(1989) FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power
EIA ANSI/EIA-455-171	(1987) FOTP-171 Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-Mode Optical Fiber Cable Assemblies
EIA ANSI/TIA/EIA-455-177A	(1992) FOTP-177 Numerical Aperture Measurement of Graded-Index Optical Fibers
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	
IEEE C2	(1997) National Electrical Safety Code
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA 250	(1991) Enclosures for Electrical Equipment (1000 volts Maximum)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1996; Errata) National Electrical Code
UNDERWRITERS LABORATORIES (UL)	
UL 910	(1995; Rev May 1995) Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 1666	(1997) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General

A fiber optics (FO) data transmission system (DTS) shall be provided. The data transmission system shall consist of fiber optic transmission media, transmitter and receiver modules, FO modems, transceiver modules, repeaters, power line surge protection and terminal devices (such as connectors, and breakout boxes). The data transmission system shall interconnect system components as shown. Computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class B computing devices and labeled as set forth in 47 CFR 15.

### 1.2.2 Environmental Requirements

Equipment and cable to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of 35 to 120 degrees F dry bulb and 10 to 95 percent relative humidity, noncondensing. Equipment shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location. Fiber optic cable for

outdoor installation shall be rated for minus 40 to plus 122 degrees F.

#### 1.2.3 NOT USED

#### 1.2.4 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

#### 1.2.5 Input Line Surge Protection

Inputs and outputs shall be protected against surges induced on wiring including wiring installed outdoors. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors (except fiber optics which serve as communications circuits from consoles to field equipment) and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

#### 1.3 DELIVERY OF TECHNICAL DATA

Computer software and technical data (including technical data which relates to computer software), which are specifically identified in this specification shall be delivered strictly in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, and in accordance with the Contract Data Requirements List (CDRL), DD Form 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. If the DTM system is being installed in conjunction with another system such as an intrusion detection system, electronic entry control system, closed circuit television system, energy monitoring and control system, or utility monitoring and control system, the Technical Data Packages shall be submitted as part of the Technical Data Package.

##### 1.3.1 Group I Technical Data Package

###### 1.3.1.1 System Drawings

The package shall include the following:

- a. Communications system block diagram.
- b. FO receivers, transmitters, transceivers, and FO modem installation, block diagrams, and wiring diagrams.
- c. FO receivers, transmitters, transceivers, and FO modem physical layout and schematics.
- d. Details of interfaces with other systems.
- e. Details of connections to power sources, including grounding.
- f. Details of surge protection device installations.

- g. Details of cable splicing and connector installations.
- h. Details of aerial cable and messenger installation on poles, cable entrance to buildings, and termination inside enclosures.
- i. Details of underground cable installation, cable entrance into buildings, and terminations inside enclosures.

#### 1.3.1.2 Equipment Data

A complete data package shall be delivered for all material, including field and system equipment.

#### 1.3.1.3 Data Transmission System Description and Analyses

The data package shall include complete system description, and analyses and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the specified performance. The data package shall include the following:

- a. FO receivers, transmitters, transceivers, FO modem transmit and receive levels, and losses in decibels (dB) on each communication link.
- b. Digital transmitter and receiver communication speed and protocol description.
- c. Analog signal transmission method and bandwidth of the transmitter and receiver.
- d. Data transmission system expansion capability and method of implementation.
- e. FO system signal-to-noise ratio calculation for each communication link.
- f. Flux-budget and gain margin calculation for each link.

#### 1.3.1.4 System Overall Reliability Calculations

The data package shall include manufacturers' reliability data and calculations required to show compliance with the specified reliability.

#### 1.3.1.5 Certifications

Specified manufacturer's certifications shall be included with the data package.

#### 1.3.2 Group II Technical Data Package

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall submit a report to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. For those changes or conditions which affect system installation or performance, specification sheets shall be provided (with the report), or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct any deficiency without written permission from the Government.

#### 1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the factory

test. A test plan and test procedures shall be prepared in accordance with Section 16751 and this specification. The test procedures shall describe the applicable tests to be performed, and other pertinent information such as specialized test equipment required, length of test, and location of the test. The procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of this specification, and the methods for simulating the necessary conditions of operation to demonstrate performance of the system. The test report shall describe the results of testing to include the date, time, location and system component designations of material and equipment tested. Testing action shall be recorded whether successful or not. Reasons for termination of testing shall be described. Testing work sheets, printouts, strip charts, oscilloscope or OTDR photographs, raw and analyzed data and testing conclusions shall be included in the report. The Contractor shall deliver the test procedures to the Government for approval. After receipt by the Contractor of written approval of the test procedures, the Contractor may schedule the factory test. The Contractor shall provide written notice of the test to the Government at least 2 weeks prior to the scheduled start. The final test report shall be delivered within 15 days after completion of the test.

#### 1.3.4 Group IV Technical Data Package

##### 1.3.4.1 Performance Verification and Endurance Testing Data

The Contractor shall prepare procedures and reports for the performance verification test and endurance test. Test procedures shall be prepared in accordance with Section 16751 and this specification. Testing shall use the configured and installed system as approved by the Government. Where required, the Contractor shall simulate conditions of operation to demonstrate the performance of the system. The test plan shall describe the applicable tests to be performed, other pertinent information such as specialized test equipment required, length of performance verification test and endurance test, and location of the performance verification test and endurance test. The procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of this specification, and the methods for simulating the necessary conditions of operation to demonstrate performance of the system.

The test report shall describe the results of testing to include the date, time, location and system component designations of material and equipment tested. Testing action shall be recorded whether successful or not. Reasons for termination of testing for any reason shall be recorded in the report. Testing work sheets, printouts, strip charts, oscilloscope or OTDR photographs, raw data, analyzed data and testing conclusions shall be included in the report. The Contractor shall deliver the performance verification test and endurance test procedures to the Government for approval. After receipt of written approval of test procedures, the Contractor may schedule the performance verification and endurance tests. The Contractor shall provide written notice of the performance verification test and the endurance test to the Government at least 2 weeks prior to the scheduled start of the test. The final performance verification test and endurance test report shall be delivered 30 days after completion of testing.

##### 1.3.4.2 Operation and Maintenance Data

A draft copy of the operation and maintenance data, in manual format, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

##### 1.3.4.3 Training Data

Lesson plans and training manuals, including type of training to be provided, with a list of reference material shall be delivered for approval

by the Government prior to starting any training.

#### 1.3.5 Group V Technical Data Package

The Group V package consists of the operation and maintenance data, in manual format. Final copies of the manuals bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and of the nearest service representative for each item of equipment and each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Manuals delivered shall include:

- a. Functional Design Manual: two copies.
- b. Hardware Manual: two copies.
- c. Operator's Manual: six copies.
- d. Maintenance Manuals: two copies.

##### 1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the data transmission system and explain the theory of operation, design philosophy, and specific functions. A description of hardware functions, interfaces, and requirements shall be included for all system operating modes.

##### 1.3.5.2 Hardware Manual

A manual describing equipment furnished, including:

- a. General description and specifications.
- b. Installation and checkout procedures.
- c. Equipment electrical schematics and layout drawings.
- d. Data transmission systems schematics.
- e. Alignment and calibration procedures.
- f. Manufacturer's repair parts list indicating sources of supply.
- g. Interface definition.

##### 1.3.5.3 Operator's Manual

The operator's manual shall fully explain procedures and instructions for operation of the system.

##### 1.3.5.4 Maintenance Manual

The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Fiber Optic System; GA.

Equipment calculations for flux budgets and gain margins.

#### SD-04 Drawings

Fiber Optic System; GA.

Detail drawings including a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function with its associated systems. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations. System drawings shall show final configuration, including location, type and termination of inside fiber optics and showing the location, duct and innerduct arrangement, or fiber assignment of outside plant. The ac power consumption and heat dissipation shall be shown under both normal and maximum operating conditions.

#### SD-06 Instructions

Manufacturers' Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be submitted prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

#### SD-08 Statements

Test Plans; GA.

Test plans shall define tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

#### SD-09 Reports

Test Reports; GA.

Test reports, in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

#### SD-13 Certificates

Manufacturer's certificate indicating compliance with transmission and reliability requirements. Where equipment or materials are specified to conform to the standards or publications and requirements of CFR, ANSI, NFPA, EIA, or UL, certificates attesting that the items furnished under this section of the specification conform to the specified requirements.

## PART 2 PRODUCTS

2.1 NOT USED

2.2 NOT USED

2.3 NOT USED

## 2.4 FO ANALOG REPEATERS

FO analog repeaters shall be used to extend the range of the FO data transmission system when necessary to meet the requirements of the paragraph SYSTEM REQUIREMENTS. For simplex circuits, the repeater shall consist of an FO receiver connected to an FO transmitter. For duplex circuits, the repeater shall consist of a pair of FO receivers that are connected to a pair of FO transmitters. The FO receivers shall receive the optical signal and drive the transmitters. The transmitters shall regenerate the optical signal in compliance with EIA 170. The FO repeater shall be mechanically and optically compatible with the remainder of the FO system.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

## 2.11 ENCLOSURES

Enclosures shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish.

## 2.11.1 Interior

Enclosures installed indoors shall meet the requirements of Type 12 or as shown.

## 2.11.2 Exterior

Enclosures installed outdoors shall meet the requirements [of Type 4] [of Type 4X metallic] [of Type 4X non-metallic] [as shown].

## 2.12 TAMPER AND PHYSICAL PROTECTION PROVISIONS

Enclosures and fittings of every description having hinged doors or removable covers, and which contain any part of the FO circuits or power supplies, shall be provided with cover-operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. The enclosure and the tamper switch shall function together to not allow direct line of sight to any internal components and tampering with the switch or the circuits before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision

at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door cover; and shall be wired so that they break the circuit when the door or cover is disturbed. Tamper switches on the doors which must be opened to make routine maintenance adjustments to the system and to service the power supplies shall be push/pull-set, automatic reset type. Covers of pull and junction boxes provided to facilitate installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by [security screws] [tack welding or brazing] to hold the covers in place. Zinc labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate that the box is part of a security system. Any damage to the enclosure or its cover's surface protection shall be cleaned and repaired using the same type of surface protection as the original enclosure.

## 2.13 SYSTEM REQUIREMENTS

### 2.13.1 Signal Transmission Format Code

FO equipment shall use the same transmission code format from the beginning of a circuit to the end of that circuit. Different transmission code formats may be used for different circuits as required to interconnect supported equipment.

### 2.13.2 Flux Budget/Gain Margin

FO links shall have a minimum gain margin of 6 dB. The flux budget is the difference between the transmitter output power and the receiver input power required for signal discrimination when both are expressed in dBm. The flux budget shall be equal to the sum of losses (such as insertion losses, connector and splice losses, and transmission losses) plus the gain margin. When a repeater or other signal regenerating device is inserted to extend the length of an FO circuit, both the circuit between the transmitter and the repeater-receiver, and the circuit between the repeater-transmitter and the receiver are considered independent FO links for gain margin calculations.

### 2.13.3 Receiver Dynamic Range

The dynamic range of receivers shall be large enough to accommodate both the worst-case, minimum receiver flux density and the maximum possible, receiver flux density. The receiver dynamic range shall be at least 15 dB. Where required, optical attenuators shall be used to force the FO link power to fall within the receiver dynamic range.

## 2.14 OPTICAL FIBERS

### 2.14.1 General

Optical fibers shall be coated with a suitable material to preserve the intrinsic strength of the glass. The outside diameter of the glass-cladded fiber shall be nominally 125 microns, and shall be concentric with the fiber core. Optical fibers shall meet EIA ANSI/EIA/TIA-455-46A, EIA ANSI/EIA-455-65, and EIA ANSI/TIA/EIA-455-177A.

### 2.14.2 NOT USED

### 2.14.3 62.5 Micron Multimode Fibers

Conductors shall be multimode, graded index, solid glass waveguides with a nominal core diameter of 62.5 microns. The fiber shall have transmission windows centered at 850 and 1330 nanometer wavelengths. The numerical aperture for each fiber shall be a minimum of 0.275. The attenuation at 850 nanometers shall be 4.0 dB/Km or less. The attenuation at 1330 nanometers shall be 1.5 dB/Km or less. The minimum bandwidth shall be 160

MHz-Km at 850 nanometers and 400 MHz-Km at 1300 nanometers. FO cable shall be certified to meet EIA ANSI/EIA/TIA-455-30B and EIA ANSI/EIA/TIA-455-58A.

#### 2.14.4 8.3 Micron Single Mode Fibers

Conductors shall be single-mode, graded index, solid glass waveguides with a nominal core diameter of 8.3 microns. The fiber shall have a transmission window centered at 1330 nanometer wavelength. The numerical aperture for each optical fiber shall be a minimum of 0.10. The attenuation at 1330 nanometers shall be 0.5 dB/Km or less. The fibers shall be certified to meet EIA ANSI/EIA/TIA-455-170.

### 2.15 CROSS-CONNECTS

#### 2.15.1 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system. Panels shall be a 19 inch rack mount type or wall mounted.

#### 2.15.2 Patch Cords

Patch cords shall be cable assemblies consisting of flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system. Patch cords shall be complete assemblies from manufacturer's standard products.

### 2.16 CABLE CONSTRUCTION

#### 2.16.1 General

The cable shall contain a minimum of two fiber optic conductors for each full duplex circuit. The number of fibers in each cable shall be as shown.

Each fiber shall be protected by a protective tube. Cables shall have a jacketed strength member, and an exterior jacket. Cable and fiber protective covering shall be free from holes, splits, blisters, and other imperfections. The covering shall be flame retardant, moisture resistant, non-nutrient to fungus, ultraviolet light resistant as specified and nontoxic. Mechanical stress present in cable shall not be transmitted to the optical fibers. Strength members shall be non-metallic and shall be an integral part of the cable construction. The combined strength of all the strength members shall be sufficient to support the stress of installation and to protect the cable in service. The exterior cables shall have a minimum storage temperature range of minus 40 to plus 167 degrees F. Interior cables shall have a minimum storage temperature of plus 14 to plus 167 degrees F. All cables furnished shall meet the requirement of NFPA 70.

Fire resistant characteristics of cables shall conform to Article 770, Sections 49, 50, and 51. A flooding compound shall be applied into the interior of the fiber tubes, into the interstitial spaces between the tubes, to the core covering, and between the core covering and jacket of all cable to be installed aerially, underground, and in locations susceptible to moisture. Flooded cables shall comply with EIA ANSI/EIA-455-81A and EIA ANSI/EIA/TIA-455-82B. Cables shall be from the same manufacturer, of the same cable type, and of the same size. Each fiber and protective coverings shall be continuous with no factory splices.

Fiber optic cable assemblies, including jacketing and fibers, shall be certified by the manufacturer to have a minimum life of 30 years. Plenum cable shall meet UL 910, and riser cable shall meet UL 1666. FO cable shall be certified to meet the following: EIA ANSI/TIA/EIA-455-13A, EIA ANSI/EIA/TIA-455-25B, EIA ANSI/TIA/EIA-455-41A, EIA ANSI/EIA/TIA-455-47B, EIA ANSI/EIA/TIA-455-59, EIA ANSI/EIA/TIA-455-61, EIA ANSI/EIA-455-88, EIA

ANSI/EIA-455-91, EIA ANSI/TIA/EIA-455-104A, and EIA ANSI/EIA-455-171.

## 2.16.2 Exterior Cable

### 2.16.2.1 Aerial Cable

The optical fibers shall be surrounded by a tube buffer, shall be contained in a channel or otherwise loosely packaged to provide clearance between the fibers and inside of the container, and shall be extruded from a material having a coefficient of friction sufficiently low to allow the fiber free movement.

- a. The cable outer jacket shall be medium density polyethylene material containing at least 2.6 percent carbon black with only black pigment added for additional coloring.
- b. Tensile strength: Cables shall withstand an installation tensile load of not less than 608 pounds and not less than 135 pounds continuous tensile load.
- c. Impact and Crush resistance: The cables shall withstand an impact of 1.7lbs/in as a minimum, and shall have a crush resistance of 317 pounds per square inch as a minimum.

### 2.16.2.2 Duct Cable

The optical fibers shall be surrounded by a tube buffer, shall be contained in a channel or otherwise loosely packaged to provide clearance between the fibers and inside of the container, and shall be extruded from a material having a coefficient of friction sufficiently low to allow the fiber free movement.

- a. The cable outer jacket shall be medium density polyethylene material with orange pigment added for ease of identification.
- b. Tensile strength: Cables shall withstand an installation tensile load of not less than 608 pounds and not less than 135 pounds continuous tensile load.
- c. Impact and Crush resistance: The cables shall withstand an impact of 1.7lbs/in as a minimum, and shall have a crush resistance of 317 pounds per square inch as a minimum.

## 2.16.3 NOT USED

## 2.16.4 Pigtail Cables

Cable used for connections to equipment shall be flexible fiber pigtail cables having the same physical and operational characteristics as the parent cable. The cable jacket shall be flame retardant PVC or FCP, which complies with NFPA 70 for OFNP applications. Maximum dB loss for pigtail cable shall be 3.5 dB/km at 850 nanometers, and 1.0 dB/km at 1330 nanometers.

## 2.17 FO CONNECTORS

FO connectors shall be the straight tip, bayonet style, field installable, self-aligning and centering. FO connectors shall match the fiber core and cladding diameters. The connector coupler shall be stainless steel and the alignment ferrule shall be ceramic. FO equipment and cable shall use the same type connectors. Connector insertion loss shall be nominally 0.3 dB and less than 0.7 dB.

## 2.18 MECHANICAL SPLICES

Mechanical splices shall be suitable for installation in the field. External power sources shall not be required to complete a splice. Splices shall be self-aligning for optimum signal coupling. Mechanical splices shall not be used for exterior applications where they may be buried underground or laced to aerial messenger cables. Mechanical splices may be used for interior locations and within enclosures. Splice closures shall protect the spliced fibers from moisture and shall prevent physical damage.

The splice closure shall provide strain relief for the cable and the fibers at the splice points.

## 2.19 CONDUIT, FITTINGS AND ENCLOSURES

Conduit shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR, and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, and as shown.

## PART 3 EXECUTION

### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Interconnections, services, and adjustments required for a complete and operable data transmission system shall be provided.

#### 3.1.1 NOT USED

#### 3.1.2 Aerial Cable

Except as otherwise specified, poles and associated aerial hardware for an overhead FO cable system shall be installed as specified in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL and as shown.

- a. A messenger cable system to support aerial cables shall be furnished. The messenger system shall be capable of withstanding a minimum of 4500 pounds of tension, including appurtenances, guys, and hardware. Messenger cables shall be galvanized zinc coated steel or aluminum clad steel.
- b. The messenger cables shall be grounded at dead ends, at the entrance to each facility, and at intervals not exceeding 1000 feet. New grounding conductors and electrodes shall be provided at each ground connection. Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.
- c. Aerial FO cables shall meet the horizontal, vertical and climbing space clearances prescribed in IEEE C2 and those of the installation.
- d. Transitions from aerial cable to underground cable shall be as specified for CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.
- e. Splices in aerial cable shall be within 3 feet of a pole and placed inside a watertight enclosure. Drip loops shall be formed at the cable entrance to the enclosure. Lashing clamps shall be placed within 12 inches of the enclosure.
- f. Loops shall be formed in the aerial cables at points of connection and at poles to prevent damage from thermal stress and wind loading. The communications cable shall be protected from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves. The ground clearance of installed

cabling shall be as shown.

- g. Cable shall be run vertically and when possible shall use gravity to assist in cable pulling. Cable shall be pulled from top of run to bottom of run. Cable shall be hand pull if possible. If machine assistance is required, tension shall be monitored using dynamometers or load-cell instruments and shall not exceed specified cable tension limits. After installation, the vertical tension on the cable shall be relieved at maximum intervals of 100 feet using a split support grip.
- h. Lashing wire shall be wound tightly around both the communication cable and the messenger cable by machine methods. The lashing wire shall have a minimum of 1 turn per 14 linear inches and not less than the number of turns per unit length that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wind loading shown or normally encountered loading for the installed location. Lashing clamps shall be placed at all poles and splices.
- i. The ice and wind loading conditions shall be per manufacturers recommendations for the geographical location:

### 3.1.3 Exterior Underground Cable

Except as otherwise specified, conduits, ducts, and manholes for underground FO cable systems shall be installed as specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown.

- a. Minimum burial depth for cable shall be 30 inches, but not less than the depth of the frost line. Burial depth specified shall take precedence over any requirements specified elsewhere.
- b. Where direct burial cable will pass under sidewalks, roads, or other paved areas and no existing conduits or duct banks are available, the cable shall be placed in a 1 inch rigid coated galvanized steel conduit or larger as required to limit conduit fill to 80 percent or less. Conduit may be installed by jacking or trenching, as approved.
- c. Buried cables shall be placed below a plastic warning tape buried in the same trench or slot. The tape shall be 12 inches above the cable. The warning tape shall be continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 48 inch intervals. The plastic tape shall be acid and alkali resistant polyethylene film, 3 inches wide with a minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 pounds per square inch lengthwise and 1500 pounds per square inch crosswise.
- d. Transitions from underground cable to aerial cable shall be as specified for CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown.
- e. For cables installed in ducts and conduit, a cable lubricant compatible with the cable sheathing material shall be used on all cables pulled. Pulling fixtures shall be attached to the cable strength members. If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics. If an indirect attachment is used on cables having only central strength members, the pulling forces shall be reduced to ensure that the fibers are not damaged from forces being transmitted to the strength member. During pulling the cable pull line tension shall be continuously monitored using

dynamometers or load-cell instruments, and shall not exceed the maximum tension specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall be such that the cable is not twisted or stretched. A cable feeder guide shall be used between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is unspooled from the reel. As the cable is unspooled from the reel, it shall be inspected for jacket defects or damage. The cable shall not be kinked or crushed and the minimum bend radius of the cable shall not be exceeded during installation. Cable shall be hand fed and guided through each manhole and additional lubricant shall be applied at all intermediate manholes. When practicable, the center pulling technique shall be used to lower pulling tension. That is, the cable shall be pulled from the center point of the cable run towards the end termination points. The method may require the cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole the cable shall be protected from dirt and moisture by laying the cable on a ground covering.

#### 3.1.4 Service Loops

Each fiber optic cable shall have service loops of not less than 9.8 feet in length at each end. The service loops shall be housed in a service loop enclosure.

#### 3.1.5 Metallic Sheath Grounding

Fiber optic cable with metallic sheath routed in the trench with a power cable shall have the metallic sheath grounded at the cable termination points.

#### 3.1.6 Splices

No splices will be permitted unless the length of cable being installed exceeds the maximum standard cable length available from a manufacturer or unless fiber optic pigtails are used to connect transmitters, receivers, or other system components for terminations to the fiber. Splices shall be made using the method recommended by the cable manufacturer. Splices shall be housed in a splice enclosure and shall be encapsulated with an epoxy, ultraviolet light cured splice encapsulant or otherwise protected against infiltration of moisture or contaminants. FO splices shall be field tested at the time of splicing. Fusion splices shall have less than 0.2 dB loss.

Mechanical splices shall have less than 0.5 dB loss. There shall be no more than 1 splice per 0.62 mile in any of the FO cables excluding terminations. Field splices shall be located in cable boxes. Sufficient cable shall be provided in each splicing location to properly rack and splice the cables, and to provide extra cable for additional splices. Cable ends shall be protected with end caps except during actual splicing. During the splicing operations, means shall be provided to protect the unspliced portions of the cable and its fibers from the intrusion of moisture and other foreign matter.

#### 3.1.7 Connectors

Connectors shall be as specified in paragraph FO CONNECTORS. Fibers at each end of the cable shall have jumpers or pigtails installed of not less than 3 feet in length. Fibers at both ends of the cable shall have connectors installed on the jumpers. The mated pair loss, without rotational optimization, shall not exceed 1.5 dB. The pull strength between the connector and the attached fiber shall not be less than 50 pounds.

#### 3.1.8 Identification and Labeling

Identification tags or labels shall be provided for each cable. Markers, tags and labels shall use indelible ink or etching which will not fade in sunlight, or in buried or underground applications. Markers, tags, and labels shall not become brittle or deteriorate for a period of 20 years. Label all termination blocks and panels with cable number or pair identifier for cables in accordance with EIA ANSI/TIA/EIA-606 and as specified. The labeling format shall be identified and a complete record shall be provided to the Government with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

### 3.1.9 Enclosure Sizing and Cable

Termination enclosures shall be sized to accommodate the FO equipment to be installed. Sizing shall include sufficient space for service loops to be provided and to accommodate a neat, workmanlike layout of equipment and the bend radii of fibers and cables terminated inside the enclosure.

### 3.1.10 Enclosure Penetrations

Enclosure penetrations shall be from the bottom and shall be sealed with rubber silicone sealant to preclude the entry of water. Conduits rising from underground shall be internally sealed.

### 3.1.11 Conduit-Enclosure Connections

Conduit-enclosure connections shall be protected by tack welding or brazing the conduit to the enclosure. Tack welding or brazing shall be done in addition to standard conduit-enclosure connection methods as described in NFPA 70. Any damage to the enclosure or its cover's surface protection shall be cleaned and repaired using the same type of surface protection as the original enclosure.

## 3.2 TESTING

### 3.2.1 General

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing.

### 3.2.2 Contractor's Field Test

The Contractor shall verify the complete operation of the data transmission system in conjunction with field testing associated with systems supported by the fiber optic data transmission system prior to formal acceptance testing. Field tests shall include a flux density test. These tests shall be performed on each link and repeated from the opposite end of each link.

#### 3.2.2.1 Optical Time Domain Reflectometer Tests

Optical time domain reflectometer tests shall be performed using the FO test procedures of EIA ANSI/EIA/TIA-455-59. An optical time domain reflectometer test shall be performed on all fibers of the FO cable on the reel prior to installation. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. Photographs of the traces shall be furnished to the Government. An optical time domain reflectometer test shall be performed on all fibers of the FO cable after it is installed. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. If the optical time domain reflectometer test results show anomalies greater than 1 dB, the FO cable segment is unacceptable to the Government. The unsatisfactory segments of cable shall be replaced with a new segment of cable. The new segment of cable shall then be tested to demonstrate acceptability. Photographs of the traces shall be furnished to the Government for each link.

### 3.2.2.2 Power Attenuation Test

Power attenuation test shall be performed at the light wavelength of the transmitter to be used on the circuit being tested. The flux shall be measured at the FO receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. If the circuit loss exceeds the calculated circuit loss by more than 2 dB, the circuit is unsatisfactory and shall be examined to determine the problem. The Government shall be notified of the problem and what procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare and submit a report documenting the results of the test.

### 3.2.2.3 Gain Margin Test

The Contractor shall test and verify that each circuit has a gain margin which exceeds the circuit loss by at least 6 dB.

## 3.3 TRAINING

### 3.3.1 General

The Contractor shall conduct a training course for designated personnel in the maintenance of the FO system. The training shall be oriented to the specific system being installed under this specification. The Contractor shall furnish training materials and supplies.

### 3.3.2 Maintenance Personnel Training

The system maintenance course shall be taught at the project site after completion of the endurance test for a period of 1 training day. A maximum of five personnel designated by the Government will attend the course. A training day shall be 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunchtime during the daytime shift in effect at the facility. Training shall include:

- a. Physical layout of the system and each piece of hardware.
- b. Troubleshooting and diagnostics procedures.
- c. Repair instructions.
- d. Preventative maintenance procedures and schedules.
- e. Calibration procedures. Upon completion of this course, the students shall be fully proficient in the maintenance of the system.

-- End of Section --

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<b>SOLICITATION, OFFER, AND AWARD</b> <i>(Construction, Alteration, or Repair)</i>	1. SOLICITATION NO. DACA27-99-B-0025	2. TYPE OF SOLICITATION <input checked="" type="checkbox"/> SEALED BID (SFB) <input type="checkbox"/> NEGOTIATED	3. DATE ISSUED 9 Aug. 1999	PAGE OF PAGES 1 of 5
	<b>IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.</b>			

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.
7. ISSUED BY  U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place Louisville, Kentucky 40202-2230	CODE	8. ADDRESS OFFER TO  U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place, Room 821 Louisville, Kentucky 40202-2230
9. FOR INFORMATION CALL:	A. NAME See Instructions	B. TELEPHONE NO. (Include area code) <b>(NO COLLECT CALLS)</b> See Instruction

**SOLICITATION**

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder."

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying no., date):

**AMMUNITION SUPPLY POINT, FORT DIX, NEW JERSEY**

This project consist of a 2,000 sf operations building, a 5,000 sf inspection building, an 8,600 sf residue turn-in building, eight (8) 2,000 sf ammunition igloos, connecting roadways, fencing, water supply well, overhead and underground telephone and other supporting utilities.

The estimated cost range of this project is from \$5,000,000.00 to \$10,000,000.00

**BID MODIFICATIONS RECEIVED BY FACSIMILE OR TELETYPE WILL NOT BE CONSIDERED.**

AWARD IS BEING MADE PURSUANT TO THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM.

DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) FAR 52.211-14: This is a rated order certified for national defense use and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR

11. The Contractor shall begin performance within 10 calendar days and complete it within \*\* calendar days after receiving  award,  notice to proceed. This performance period is  mandatory,  negotiable. (See **\*\*Section 00800, Para 1.**)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	12B. CALENDAR DAYS 10
---	--------------------------

13. ADDITIONAL SOLICITATION REQUIREMENTS:

- A. Sealed offers in original and 2 copies to perform the work required are due at the place specified in Item 8 by 2:00 p.m. local time 8 September 1999. If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.
- B. An offer guarantee  is,  is not required.
- C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.
- D. Offers providing less than 120 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

14. NAME AND ADDRESS OF OFFEROR (Include ZIP Code)  DUNS #  CODE                      FACILITY CODE	15. TELEPHONE NO. (Include area code)  16. REMITTANCE ADDRESS (Include only if different than Item 14)  TIN #
---	---

17. The offeror agrees to perform the work at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government within   120   calendar days after the date offers are due. (Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)

AMOUNTS	Bidders shall show his prices on the Bid Schedule of this section.
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18. The offeror agrees to furnish any required performance and payment bonds.

**19. ACKNOWLEDGMENT OF AMENDMENTS**

*The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each*

AMENDMENT NO.									
DATE									

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)	20B. SIGNATURE	20C. OFFER DATE
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**AWARD (To be completed by Government)**

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA
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24. SUBMIT INVOICES TO ADDRESS SHOWN IN (4 copies unless otherwise specified) Will be identified in Delegation letters.	ITEM: Sec 105 Para. 30	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO <input type="checkbox"/> 10 U.S.C. 2304(c)( ) <input type="checkbox"/> 41 U.S.C. 253(c)( )
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26. ADMINISTERED BY                      CODE  U.S. Army Engineer District, Louisville Corps of Engineers, P.O. Box 59 Louisville, KY 40201-0059	27. PAYMENT WILL BE MADE BY  USACE Finance Ctr. (UFC) 5720 Integrity Drive                      EFT:T Millington, TN 38054-5005
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**CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE**

<input type="checkbox"/> 28. NEGOTIATED AGREEMENT (Contractor is required to sign this document and return ___ copies to issuing office.) Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration slated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.	<input type="checkbox"/> 29. AWARD (Contractor is not required to sign this document) Your offer on this solicitation is hereby accepted as to the item listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.
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30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN (Type or print)	31A. NAME OF CONTRACTING OFFICER (Type or print)
--	--

30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA  BY	31C. AWARD DATE
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ALL BIDDERS READ THE FOLLOWING INSTRUCTIONS

1. Each bidder shall, upon request of the Contracting Officer, furnish a list of the plant available to the bidder and proposed for use of the work.
2. Bidders are cautioned that drawings may not be reproduced to exact scale. All drawings, whether full size or reduced, should be checked for potential discrepancies, dimensions and scales should be verified and all drawings compared.
3. Bidders are required to acknowledge receipt of all amendments to this solicitation on Standard Form 1442 in the space provided, by completing Blocks 8 and 15 of the Amendment Form (SF 30), by separate letter, or by telegram prior to opening of bids. Failure to acknowledge all amendments may cause rejection of the bid/proposal.
4. Telegraph modifications may be received at the bidding office by telephone from the receiving telegraph company. The telegraph company shall call (502) 582-5591 to deliver the message. The telegraph company shall confirm the message by sending a copy of the written telegram to the bidding office within 7 calendar days of delivery of the telephone message.

# CAUTION TO BIDDERS

**BEFORE SIGNING AND MAILING THIS BID, PLEASE TAKE NOTE OF THE FOLLOWING, AS FAILURE TO PERFORM ANY ONE OF THESE ACTIONS MAY CAUSE YOUR BID TO BE REJECTED.**

1. **AMENDMENTS**. Have you acknowledge receipt of ALL amendments? If in doubt as to the number of amendments issued, please contact our office.
2. **AMENDED BID PAGES**. If any of the amendments furnished amended bid pages, the amended bid pages must be used for preparation of your bid.
3. **LATE BIDS**. Please refer to the Instructions section contained in this package.
4. **BID GUARANTEE**. If bid guarantee is required for this project, sufficient bid guarantee in proper form must be furnished with your bid for construction projects exceeding \$100,000.
5. **MISTAKE IN BID**. Have you reviewed your bid prices for possible errors in calculations or work left out?
6. **FAX MODIFICATIONS OF BIDS**. We do not permit modifications of bids by fax.

**BID SCHEDULE****CONTINUATION SHEET**

REFERENCE NO. DOCUMENT BEING CONTUNUED

PAGE 5 of 5

DACA27-99-B-0025

NAME OF OFFEROR OR CONTRACTOR

ITEM NO.	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
	Fort Dix, New Jersey Ammunition Supply Point				
1	Inspection Building to the five (5) foot line.	1	JOB		\$ _____
2	Residue Turn-In Building to the five (5) foot line.	1	JOB		\$ _____
3	Operations Building to the five (5) foot line.	1	JOB		\$ _____
4	Pump House Building to the five (5) foot line.	1	JOB		\$ _____
5	Eight (8) Storage Magazines to the five (5) foot line.	1	JOB		\$ _____
6	Site Work	1	JOB		\$ _____
	<b>TOTAL BASE</b>				\$ _____
1	<b>BID OPTIONS</b>				
	Two (2) Ammunition Storage Magazine, including site work	1	JOB		\$ _____
	<b>Total Base Bid and Option</b>				\$ _____
	Prices for the options shall be good for <u>90</u> days after award of the contract. The project duration shown in Section 00800, para. 1 will not be affected by the exercising of the options.				
	<u>Special Bid Conditions.</u> If a modification to a bid based on unit prices is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.				

**BID SCHEDULE**

**CONTINUATION SHEET**

REFERENCE NO. DOCUMENT BEING CONTUNUED

PAGE 5 of 5

DACA27-99-B-0025

NAME OF OFFEROR OR CONTRACTOR

ITEM NO.	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT

16 February 1999

## SECTION 00100

## INSTRUCTIONS FOR SEALED BID CONTRACTS

2 Jan 96

## 1. SOLICITATION DEFINITIONS - SEALED BIDDING - (July 1987) FAR 52.214-1.

"Government" means United States Government. "Offer" means "bid" in sealed bidding. "Solicitation" means an invitation for bids in sealed bidding.

## 2. AMENDMENTS TO INVITATIONS FOR BIDS (DEC 1989) FAR 52.214-3.

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, 3) by letter or telegram, or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids.

## 3. FALSE STATEMENTS IN BIDS (APR 1984) FAR 52.214-4.

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

20 March 1997

## 4. SUBMISSION OF BIDS (MAR 1997) FAR 52.214-5 (Para. a-e only).

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages, (unless submitted by electronic means).

- (1) Addressed to: U.S. Army Engineer District, Louisville  
600 Dr. Martin Luther King, Jr. Place  
Room 821  
Louisville, Kentucky 40202-2230

(2) Showing the time specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a)(1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice.

(d) Facsimile bids, modifications, or withdrawals will not be considered unless authorized by the solicitation.

(e) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.

(f) Hand-carried bids shall be deposited in the depository located in Room 821, Federal Building, 600 Dr. Martin Luther King, Jr. Place, Louisville, Kentucky.

(g) Express mail bids shall be addressed as shown in Paragraph (a) (1) above, ATTN: CEORLCT/Hitner.

5. EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984) FAR 52.214-6.

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

20 March 1997

6. LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (MAY 1997)  
FAR 52.214-7.

(a) Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it--

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for the receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th); or

(2) Was sent by mail (or telegram or facsimile, if authorized) or hand-carried (including delivery by a commercial carrier) if it is determined by the Government that the late receipt was due primarily to Government mishandling after receipt at the Government installation;

(3) Was sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee, not later than 5:00 P.M. at the place of mailing two working days prior to the date specified for receipt of bids. The term "working days" excludes weekends and U.S. Federal holidays; or

(4) Was transmitted through an electronic commerce method authorized by the solicitation and was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids.

(b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.

(c) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date or the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(d) The only acceptable evidence to establish the time of receipt at the Government installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.

(e) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph (c) of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(f) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

(g) Bids may be withdrawn by written notice or telegram (including mailgram) received at any time before the exact time set for receipt of bids. If the solicitation authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids subject to the conditions specified in the provision entitled "Facsimile Bids." A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identify of the person requesting withdrawal is established and the person signs a receipt for the bid.

(h) If an emergency or unanticipated event interrupts normal Government processes so as to cause postponement of the scheduled bid opening, and urgent Government requirements preclude amendment of the solicitation or other notice of an extension of the opening date, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

#### 7. PREPARATION OF BIDS - CONSTRUCTION (APR 1984) FAR 52.214-18.

(a) Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit prices for one or more items on various bases, including -

- (1) Lump sum bidding;
- (2) Alternate prices;
- (3) Units of construction; or
- (4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

8. NOT USED.

9. NOT USED.

#### 10. BIDDER'S QUALIFICATIONS.

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization,

financial resources, and plant available to be used in performing the work. The successful bidders will be required to submit his Workman's Compensation Experience Modification Rate (EMR) for the previous 3 years.

11. NOT USED

28 March 1998

12. BID GUARANTEE (SEP 1996) FARS 52.228-1 (Para. (a) - (e) only).

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, such as a bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(c) The amount of the bid guarantee shall be 20 percent of the bid price or \$3,000,000, whichever is less.

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.

(e) In the event the contract is terminated for default, the Bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(f) The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents. Bid bonds are not required for projects under \$100,000.

(g) Individual Sureties. See Paragraph 15.

20 March 1997

13. PERFORMANCE AND PAYMENT BONDS. After the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to the Government shall be furnished: a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A). The penal sums of such bonds will be as follows:

(a) Performance Bond. The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.

(b) Payment Bond.

(1) When the contract price is \$1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.

(2) When the contract price is in excess of \$1,000,000 but not more than \$5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(3) When the contract price is more than \$5,000,000 the penal sum shall be \$2,500,000.

(c) For rules covering the use of individual sureties see Paragraph 15. Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of contract performance.

14. NOT USED.

15. RULES FOR USE OF INDIVIDUAL SURETIES.

(a) One individual surety is adequate support for a bond, provided the unencumbered value of the assets pledged by that individual surety equal or exceed the amount of the bond. An offeror may submit up to three individual sureties for each bond, in which case the pledged assets when combined must equal or exceed the penal amount of the bond. Each individual surety must accept both joint and several liability to the extent of the penal amount of the bond.

(b) An individual surety may be accepted only if a security interest in acceptable assets is provided to the Government by the individual surety. The security interest shall be furnished with the bond, and may be provided by one or a combination of the following methods:

(1) An escrow account with a federally insured financial institution in the name of the contracting agency.

(2) A lien on real property, subject to restrictions contained herein.

(c) Acceptable assets include:

(1) Cash or certificates of deposit, or other cash equivalents with a federally insured financial institution;

(2) United States Government securities at market value;

(3) Stocks and bonds actively traded on a national U.S. security exchange with certificates issued in the name of the individual surety (these assets will be accepted at 90 percent of their 52 week low, as reflected at the time of submission of the bond);

(4) Real property owned in fee simple by the surety without any form of concurrent ownership (these assets will be accepted at 100 percent of the most current tax assessment value exclusive of encumbrances or 75 percent of the properties' unencumbered market value provided a current appraisal is furnished);

(5) Irrevocable letters of credit (ILC) issued by a federally insured financial institution in the name of the contracting agency and which identify the agency and solicitation or contract number for which the ILC is provided.

(d) Unacceptable assets include but are not limited to:

(1) Notes or accounts receivable;

(2) Foreign securities;

(3) Real property as follows:

a. Real property located outside the United States, its territories, or possessions.

b. Real property which is a principal residence of the surety.

c. Real property owned concurrently regardless of the form of co-tenancy except where all co-tenants agree to act jointly.

d. Life estates, leasehold estates, or future interests in real property.

(4) Personal property such as jewelry, furs, antiques;

(5) Stocks and bonds of the individual surety in a controlled, affiliated, or closely held concern of the Offeror/Contractor;

(6) Corporate assets (e.g., plant and equipment);

(7) Speculative assets (e.g., mineral rights);

(8) Letters of credit, except as provided in subparagraph c(5) above.

(e) With respect to the acceptance of real property, the individual surety shall provide:

(1) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice;

(2) Evidence of the amount due under any encumbrance shown in the evidence of title;

(3) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice.

(4) Failure to provide evidence that the lien has been properly recorded will render the offeror nonresponsible.

(f) An individual may be excluded from acting as individual surety on bonds for any of the following causes:

(1) Failure to fulfill the obligations under any bond.

(2) Failure to disclose all bond obligations.

(3) Misrepresentation of the value of available assets or outstanding liabilities.

(4) Any false or misleading statement, signature or representation on a bond or affidavit of individual suretyship.

(5) Any other cause affecting responsibility as a surety of such serious and compelling nature as may be determined to warrant exclusion.

An individual surety excluded pursuant to this subsection shall be included on the list entitled "Parties Excluded from Procurement Programs."

(g) Any bidder or offeror should carefully review these requirements which are set forth in Section 28 of the Federal Acquisition Regulations (FAR).

20 March 1997

16. SITE VISIT FAR (APR 1984) 52.237-1.

Offerors or quoters are urged and expected to inspect the site where services are to be performed and to satisfy themselves regarding all general and local conditions that may affect the cost of contract performance, to the extent that the information is reasonably obtainable. In no event shall failure to inspect the site constitute grounds for a claim after contract award. Site visits may be arranged during normal duty hours by contacting:

Paul Kara  
Resident Office  
New York District  
Building 5212  
Maryland Avenue  
Fort Dix, NJ 08640

22 Jan 99

17. REQUESTS FOR INFORMATION. Telephone inquiries relating to this procurement should be directed to the Louisville District, Corps of Engineers, as listed below: ORAL EXPLANATIONS OR INSTRUCTIONS GIVEN BEFORE THE AWARD OF A CONTRACT WILL NOT BE BINDING. SEE PARAGRAPH 5: "EXPLANATION TO PROSPECTIVE BIDDERS" FOR PROPER PROCEDURES.

Procurement of Plans  
& Specifications--Denise Gill.....502/582-6544  
Prospective Bidders may find the planholders list on the Internet at  
[http://www.lrl.usace.army.mil/ct/ct\\_pages.htm](http://www.lrl.usace.army.mil/ct/ct_pages.htm)

Technical Questions on Plans  
& Specifications -Harrison Fox .....502/582-6909  
Fax.....502/582-6763

18. LOCATION OF BID OPENING. Directions and map to the bid opening address are attached at the end of this section.

19. NOT USED.

20. NOT USED.

21. NOT USED.

22. NOT USED.

16 Feb 1999

23. INDUSTRY SMALL BUSINESS SIZE STANDARDS (JAN 1999) FAR 19.102.

23.1 General.

(a) The SBA establishes small business size standards on an industry-by-industry basis. (See 13 CFR 121.)

(b) Small business size standards are applied by--

(1) Classifying the product or service being acquired in the industry whose definition, as found in the Standard Industrial Classification (SIC) Manual, best describes the principal nature of the product or service being acquired.

(2) Identifying the size standard SBA established for that industry;  
and

(3) Specifying the size standard in the solicitation, so that offerors can appropriately represent themselves as small or large.

(c) For size standard purposes, a product or service shall be classified in only one industry, whose definition best describes the principal nature of the product or service being acquired even though for other purposes it could be classified in more than one.

(d) When acquiring a product or service that could be classified in two or more industries with different size standards, contracting officers shall apply the size standard for the industry accounting for the greatest percentage of the contract price.

(e) If a solicitation calls for more than one item and allows offers to be submitted on any or all of the items, an offeror must meet the size standard for each item it offers to furnish. If a solicitation calling for more than one item requires offers on all or none of the items, an offeror may qualify as a small business meeting the size standard for the item accounting for the greatest percentage of the total contract price.

(f) Any concern which submits a bid or offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is deemed to be a small business when it has no more than 500 employees, and---

(1) In the case of Government acquisitions set-aside for small businesses, such nonmanufacturer must furnish in the performance of the contract the product of a small business manufacturer or producer, which end product must be manufactured or produced in the United States. The term "nonmanufacturer" includes a concern which can manufacture or produce the product referred to in the specific acquisition but does not do so in connection with that acquisition. For size determination purposes there can be only one manufacturer of the end item being procured. The manufacturer of the end item being acquired is the concern which, with its own forces, transforms inorganic or organic substances including raw materials and/or miscellaneous parts or components into such end item. Whether a bidder on a particular acquisition is the manufacturer or a nonmanufacturer for the purpose of a size determination need not be consistent with whether such concern is or is not a manufacturer for the purpose of the Walsh-Healey Act.

(2) A concern which purchases items and packages them into a kit is considered to be a nonmanufacturer small business and can qualify as such for a given acquisition if it meets the size qualifications of a small nonmanufacturer for acquisition, and if more than 50 percent of the total value of the kit and its contents is accounted for by items manufactured by small business.

(3) For the purpose of receiving a Certificate of Competency on an unrestricted acquisition, a small business nonmanufacturer may furnish any domestically produced or manufactured product.

23.2 The industry size standards are set forth in the following table. The table column labeled "SIC" follows the standard industrial classification code as published by the Government in the Standard Industrial Classification Manual. The Manual is intended to cover the entire field of economic activities. It classifies and defines activities by industry categories and is the source used by SBA as a guide in defining industries for size standards. The number of employees or annual receipts indicates the maximum allowed for a concern, including its affiliates, to be considered small.

23.3 Size standards for construction and special trades.

A concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed \$17 million. However, if 75 percent or more of the work (in terms of dollar value) called for by the contract is

classified in one of the industries, subindustries, or classes of products listed in this paragraph, the concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed the size standard for that industry, subindustry, or class of products. (See Division C, "Contract Construction," of the SIC Manual).

Classification Code	Industry, Subindustry, or Class of Products	Size Standard*
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MAJOR GROUP 15--BUILDING CONSTRUCTION--GENERAL CONTRACTORS  
AND OPERATIVE BUILDERS

1521	General Contractors--Single-Family House	\$17.0
1522	General Contractors--Residential Buildings, Other Than Single-Family	17.0
1531	Operative Builders	17.0
1541	General Contractors--Industrial Buildings and Warehouses	17.0
1542	General Contractors--Nonresidential Buildings Other Than Industrial Buildings and Warehouse	17.0

MAJOR GROUP 16--CONSTRUCTION OTHER THAN BUILDING  
CONSTRUCTION--GENERAL CONTRACTORS

1611	Highway and Street Construction, Except Elevated Highway	17.0
1622	Bridge, Tunnel, and Elevated Highway Construction	17.0
1623	Water, Sewer, Pipe Line, Communication and Power Line Construction	17.0
1629	Heavy Construction, Except Dredging N.E.C.	17.0
1629	Dredging and Surface Cleanup Activities	13.5

MAJOR GROUP 17--CONSTRUCTION--SPECIAL TRADE  
CONTRACTORS

1711	Plumbing, heating (except electric), and air conditioning	\$7
1721	Painting, paperhanging, and decorating	7
1731	Electrical Work	7
1741	Masonry, stone setting, and other stonework	7
1742	Plastering, drywall, acoustical and insulation work	7
1743	Terrazzo, tile, marble, and mosaic work	7
1751	Carpentry Work	7
1752	Floor laying and other floorwork, not elsewhere classified	7
1761	Roofing, siding and sheet metal work	7
1771	Concrete work	7
1781	Water well drilling	7
1791	Structural steel erection	7
1793	Glass and glazing work	7
1794	Excavating and foundation work	7
1795	Wrecking and demolition work	7
1796	Installation or erection of building equipment, not elsewhere classified	7
1799	Special trade contractors, not elsewhere classified	7

\* (Average Annual Receipts) (Millions)

24. CONTRACT PRICES - BIDDING SCHEDULES (DEC 1991) DFARS 52.236-7008.

(a) The Government's payment for the items listed in the Bidding Schedule shall constitute full compensation to the Contractor for--

(1) Furnishing all plant, labor, equipment, appliances, and materials;  
and

(2) Performing all operations required to complete the work in conformity with the drawings and specifications.

(b) The Contractor shall include in the prices for the items in the Bidding Schedule all costs for work in the specifications, whether or not specifically listed in the Bidding Schedule.

2 Jan 96

25. ARITHMETIC DISCREPANCIES EFARS 52.214-5000.

(a) For the purpose of initial evaluations of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by the bidder:

- (1) Obviously misplaced decimal points will be corrected;
- (2) In case of discrepancy between unit prices and extended price, the unit price will govern;
- (3) Apparent errors in extension of unit prices will be corrected; and
- (4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

1 February 1995

26. WAGE RATES. The Wage Decisions of the Secretary of Labor are applicable to the work to be performed under this contract and are contained in SECTION 00800, SPECIAL CONTRACT REQUIREMENTS. Modifications are periodically made to the wage decisions. The complete modifications will be issued by amendment to the solicitation.

24 Sep 1998

27. MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS. The right is reserved, as the interest of the Government may require, to revise or amend the specifications and/or drawings prior to the date set for opening of bids. Such revisions and amendments, if any, will be announced by an amendment or amendments to this Invitation for Bids. Copies of such amendments as may be issued will be furnished to all prospective bidders. If the revisions and amendments are of a nature which require material changes in quantities or prices bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the Contracting Officer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.

24 Sep 1998

(1)28. NOTICE OF BUY AMERICAN ACT REQUIREMENTS - CONSTRUCTION MATERIALS. (MAY 1997) FAR 52.225-12

(a) Offerors are required to comply with the requirements of Federal Acquisition Regulation (FAR) clause 52.225-5, Buy American Act - Construction Materials, of this solicitation. The terms "construction material" and "domestic construction material," as used in this provision, have the meanings set forth in FAR clause 52.225-5.

(b) Offerors should request a determination regarding the inapplicability of the Buy American Act in time to allow determination before submission of offers. For evaluation of a request for a determination regarding the inapplicability of the requirements of the Buy American Act prior to the time set for receipt of offers, the information and applicable supporting data required by paragraphs (c) and (d) of FAR clause 52.225-5 shall be included in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act prior to submission of its offer, or has not received a response to a request made prior to submission of its offer, the information and supporting data shall be included in the offer.

(c) Evaluation of offers.

(1) For evaluation of offers, (unless agency regulations specify a higher percentage) the Government will add to the offered price 6 percent of the cost of any foreign construction material proposed for exception from the requirements of the Buy American Act based on claimed unreasonable cost of domestic construction materials in accordance with paragraph (b)(3)(i) of FAR clause 52.225-5.

(2) If the evaluation of offers results in a tie between an offer including such foreign construction material excepted on the basis of unreasonable cost, as evaluated, and an offer including solely domestic construction material or other foreign construction material listed in the solicitation at paragraph (b)(2) of FAR clause 52.225-5, or subsequently excepted in accordance with paragraphs (b)(3)(ii) or (iii) of FAR clause 52.225-5, award shall be made to the offeror that submitted the latter offer.

(d) Alternate offers.

(1) When an offer includes foreign construction material not listed by the Government in the solicitation at paragraph (b)(2) of FAR clause 52.225-5, offerors also may submit alternate offers base on use of equivalent domestic construction.

(2) If alternate offers are submitted, a separate Standard Form 142 shall be submitted for each alternate offer, and a separate price comparison table, prepared in accordance with paragraph (c) and (d) of FAR clause 52.225-5, shall be submitted for each offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception to apply.

(3) If the Government determines that a particular exception requested under paragraph (c) of FAR clause 52.225-5 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic construction material, and the offeror shall be required to furnish such domestic construction material.

(i) In sealed bid procurements, any offer based on use of that particular foreign construction material shall be rejected as nonresponsive.

(ii) In negotiated procurements, any offer based on use of that particular foreign construction material may not be accepted unless revised during negotiations.

29. LISTING OF EMPLOYMENT OPENINGS. Offerors should note that this solicitation includes a provision requiring the listing of employment openings with the local office of the State employment service system if the award is for \$10,000 or more.

22 June 1998

30. SUBMISSION OF INVOICES.

In accordance with Section 00010, Para. 24, submit invoices to:

Paul Kara  
 Resident Office  
 New York District  
 Building 5212  
 Maryland Avenue  
 Fort Dix, NJ 08640

16 Feb 1999

31. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999) FAR 52.222-23.

(a) The Offeror's attention is called to the EQUAL OPPORTUNITY and the AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION clauses of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

.....		
Goals for minority participation for each trade		Goals for female participation in each trade
		6.9%
Electricians	9.0 to 10.2%	
Carpenters	27.6 to 32.0%	
Steam Fitters	12.2 to 13.5%	
Metal Lathers	24.6 to 25.6%	
Painters	23.6 to 26.0%	
Operating engineers	25.6 to 26.0%	
Plumbers	12.0 to 14.5%	
Iron workers (struct)	25.9 to 32.0%	
Elevator constructors	5.5 to 6.5%	
Bricklayers	13.4 to 15.5%	
Asbestos workers	22.8 to 28.0%	
Roofers	6.3 to 7.5%	
Iron workers (ornamental)	22.4 to 23.0%	
Cement masons	23.0 to 27.0%	
Glaziers	16.0 to 20.0%	
Plasterers	15.8 to 18.0%	
Teamsters	22.0 to 22.5%	
Boilermakers	13.0 to 15.5%	
All others	16.4 to 17.5%	

.....

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the Contractor performs construction work (whether or not it is Federal or Federally assisted) in a geographical area located outside the covered area, it shall apply the goals established for the geographical area where such work is actually performed. Goals are published periodically in the Federal

Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs (OFCCP) Office.

(c) The Contractor's compliance with Executive Order 11246 as amended and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity clause, specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction" and its efforts to meet prescribed goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary, for Federal Contract Compliance, U.S. Department of Labor within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the---

- (1) Name, address and telephone number of the subcontractor; (2) Employer's identification number of the subcontractor; (3) Estimated dollar amount of the subcontract;
- (4) Estimated starting and completion dates of the subcontract;

and

- (5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in the contract resulting from this Solicitation, the "covered area" is Burlington County, New Jersey, which includes the Philadelphia, PA economic area.

16 Feb 1999

32. SUBCONTRACTING PLANS FOR SMALL BUSINESS CONCERNS. Bidders are cautioned that compliance with CONTRACT CLAUSE: SMALL BUSINESS SUBCONTRACTING PLAN requires that the apparent low bidder, upon request by the Contracting Officer, submit a subcontracting plan for subcontracting with small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns. Bidders desiring assistance in developing a source list are encouraged to contact small business, HUBZone small business, small disadvantaged, and women-owned small business associations and appropriate Offices of Small and Disadvantaged Business Utilization, addresses which may be obtained from the District Labor Adviser, U.S. Army Engineer District, P.O. Box 59, Louisville, Kentucky 40201 (Telephone 502/582-5679).

33. NOT USED.

15 September 1995

34. MODIFICATION OF BIDS BY FACSIMILE. Bidders WILL NOT be allowed to modify their bids at any time by facsimile or teletype.

35. PAYMENT FOR BOND PREMIUMS. CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS provides that upon presentation of evidence of full payment, the Government will immediately reimburse the Contractor the cost of premiums for performance and payment bonds. This reimbursement amount is not in addition to the amount bid for the work covered by this Invitation for Bids, and bidders are cautioned to include the cost of such premiums in the bid items shown on the Bidding Schedule (or in the lump sum amount of the bid if no bid items are listed). If bond premiums are reimbursed under this clause, such reimbursed amount will be recovered by the Government from the progress payments made to the Contractor or, if no

progress payments are made, from the amount otherwise due the Contractor upon final payment.

36. NOT USED.

37. NOT USED.

38. SERVICE OF PROTEST (AUG 1996) FAR 52.233-2.

(a) Protests, as defined in Section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from:

Ms. Denise A. Bauer, Contracting Officer  
U.S. Army Engineer District, Louisville  
Corps of Engineers - ATTN: CEORLCT  
600 Dr. Martin Luther King Jr. Place, Room 821  
Louisville, Kentucky 40202-2230

(b) The copy of any protest shall be received in the office designated above on the same day a protest is filed with the GSBICA or within one day of filing a protest with the GAO.

39. COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (DEC 1991)  
DFARS 252.204-7001

(a) The Offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter CAGE before the number.

(b) If the Offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Services Center (DLSC). The Contracting Officer will--

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLSC; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

20 March 1997

40. DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (APR 1998) FAR 52.204-6.

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number is a nine-digit number assigned by Dun and Bradstreet Information Services.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

- (1) Company name.
- (2) Company address.
- (3) Company telephone number.

- (4) Line of business.
- (5) Chief executive officer/key manager.
- (6) Date the company was started.
- (7) Number of people employed by the company.
- (8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at <http://www.dnb.com/>. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at [globalinfo@mail.dnb.com](mailto:globalinfo@mail.dnb.com).

41. NOT USED.

20 March 1997

42. NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990) FAR 52.211-14.

42.1 Any contract awarded as a result of this solicitation will be a [ ] DX rated order; [X] DO-C2 rated order certified for national defense use under the Defense Priorities and Allocations System (DFARS) 15 CFR 700, and the Contractor will be required to follow all of the requirements of this regulation.

43. PRICE BASIS. Prices must be firm. Bids will not be considered which provide for subsequent increase in price.

24 Sep 1998

44. CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (AUG 1996) FAR 52.214-19.

(a) The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

(b) The Government may reject any or all bids, and waive informalities on minor irregularities in bids received.

(c) The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

(d) The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

45. NOT USED.

(1)46. AWARD TO SINGLE BIDDERS. Subject to the provisions contained herein, award shall be made to a single bidder. Bids must include unit prices for each item listed in order that bids may be properly evaluated. Failure to do this shall be cause for rejection of the entire bid. Bids shall be evaluated on the basis of the estimated quantities shown, and award shall be made to that responsible bidder whose total aggregate price is low, subject to the requirements of Para. 47 below.

47. NOT USED.

48. NOT USED.

49. NOT USED.

LOCATION OF BID OPENING. Bidders are provided the following information as a service by the government. The government cannot be held liable for street closures, traffic delays or other problems that may be encountered due to reliance upon the government's suggested routes to the Federal Building.

**Motorist coming from I-65 North:**

Immediately after crossing the Kennedy bridge, take exit I-64 West (St. Louis). Once in I-64, take the 9th street exit. Continue straight on 9th street for approximately seven blocks to Broadway (first major street with two-way traffic). Turn left on Broadway; go two blocks and turn left on 7th street (7th street is one-way north bound). Approximately 1/2 block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-65 South:**

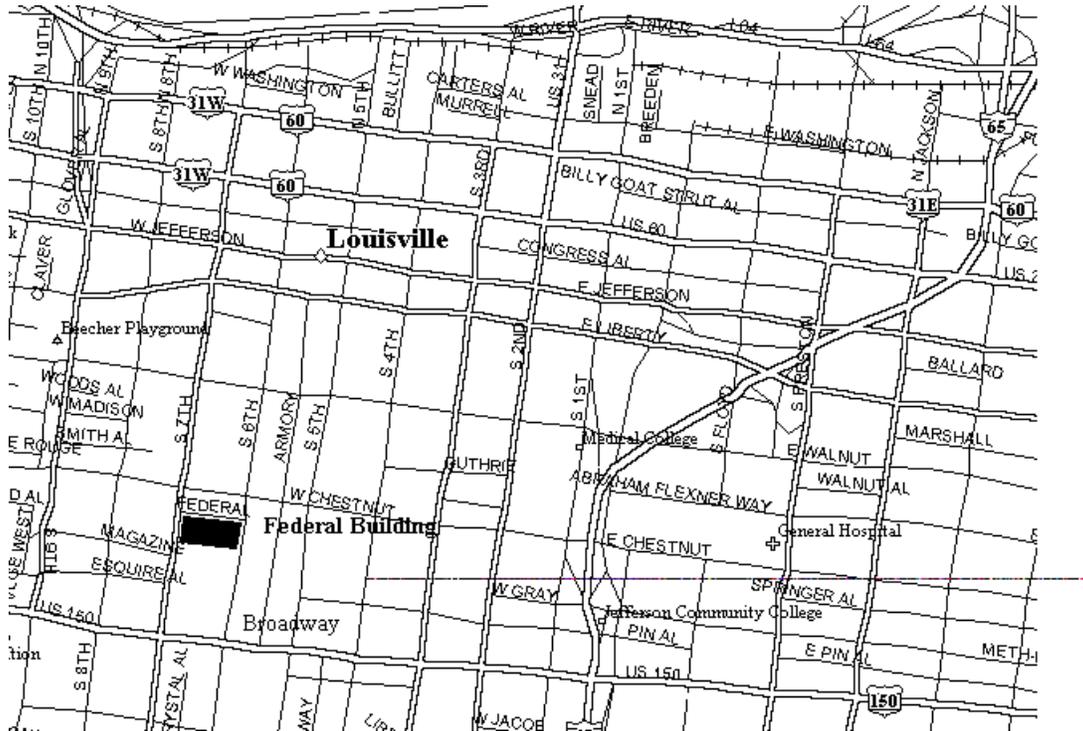
Take Broadway exit and turn left on Broadway (west bound) and continue to 7th street and turn right. Approximately 1/2 block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-64 East and West:**

Exit the 9th street exit. At the bottom of the ramp continue south down 9th street for approximately seven blocks until you come to Broadway (first major two way street). Turn left on Broadway and to two blocks and turn left on 7th street (7th street is one-way north bound). Approximately 1/2 block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-71:**

Follow routing for intersecting with I-64 and follow the instructions for I-64 motorists.



**BIDDER: READ CAREFULLY - CHECK ALL APPLICABLE BOXES**

**SECTION 00600**

**REPRESENTATIONS, CERTIFICATIONS, AND OTHER STATEMENTS OF BIDDER  
FOR SEALED BID CONSTRUCTION CONTRACTS**

**DATE OF OFFER:** \_\_\_\_\_ **DUNS NO.** \_\_\_\_\_

**SOLICITATION NO.** \_\_\_\_\_ **CAGE NO.** \_\_\_\_\_

**NAME AND ADDRESS OF OFFEROR:** \_\_\_\_\_

The offeror makes the following representations and certifications as part of the offer referenced above.

**1. CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985) FAR 52.203-2**

(a) The offeror certifies that--

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory--

(1) Is the person in the offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision \_\_\_\_\_ [*insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization*];

(ii) As an authorized agent, does certify that the principals name in subdivision (b)(2)(i) of this provision have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of provision)

## **2. CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991) FAR 52.203-11**

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(End of Provision)

**3. TAXPAYER IDENTIFICATION (OCT 1998) FAR 52.204-3**

**(a) Definitions.**

“Common parent,” as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Taxpayer Identification Number (TIN),” as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

**(d) Taxpayer Identification Number (TIN).**

- ] TIN: \_\_\_\_\_
- ] TIN has been applied for.
- ] TIN is not required because:
  - ] Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;
  - ] Offeror is an agency or instrumentality of a foreign government;
  - ] Offeror is an agency or instrumentality the Federal Government;

**(e) Type of Organization.**

- ] Sole proprietorship;
- ] Partnership;
- ] Corporate entity (not tax-exempt);
- ] Corporate entity (tax-exempt);
- ] Government entity (Federal, State, or local);
- ] Foreign government;
- ] International organization per 26 CFR 1.6049-4;
- ] Other \_\_\_\_\_

**(f) Common Parent.**

Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

Name and TIN of common parent:

Name \_\_\_\_\_ TIN \_\_\_\_\_  
(End of provision)

**4. WOMEN-OWNED BUSINESS (OCT 1995) FAR 52.204-5**

**(a) Representation.** The offeror represents that it  is,  is not a women-owned business concern.

**(b) Definition.** “Women-owned business concern,” as used in this provision, means a concern which is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(End of provision)

**5. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (MAR 1996) FAR 52.209-5**

(a) (1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are  are not  presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have  have not , within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are  are not  presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has  has not , within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) “Principals,” for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

## **6. DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (SEP 1994) DFARS 252.209-7001**

### **(a) Definitions.**

As used in this provision--

(1) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405 (j)(i)(A)), to be a country the government of which has repeatedly provided support for acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means--

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

- (ii) Holding a management position in the firm, such as a director or officer;
- (iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;
- (iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or
- (v) Holding 50 percent or more of the indebtedness of a firm.

(b) **Prohibition on award.** In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) **Disclosure.** If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclose such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include--

- (1) Identification of each government holding a significant interest; and
  - (2) A description of the significant interest held by each government.
- (End of provision)

#### **7. COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (MAR 1998) DFARS 52.209-7003**

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 38 U.S.C. 4212(d) (i.e., the VETS-100 report required by Federal Acquisition Regulation clause 52.222-37, Employment Reports on Disabled Veterans and Veterans of the Vietnam Era), it has submitted the most recent report required by 38 U.S.C. 4212(d).

(End of provision)

#### **8. SMALL BUSINESS PROGRAM REPRESENTATIONS (OCT 1998) FAR 52.219-1 (ALTERNATE I) (OCT 1998)**

- (a) (1) The standard industrial classification (SIC) code for this acquisition is 1542.
  - (2) The small business size standard is \$17.0 million.
  - (3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.
- (b) **Representations.** (1) The offeror represents as part of its offer that it [ ] is, [ ] is not a small business concern.

(2) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it [ ] is, [ ] is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it [ ] is [ ] is not a women-owned small business concern.

(4) (Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision). [The offeror shall check the category in which its ownership falls];

\_\_\_\_\_ Black American

\_\_\_\_\_ Hispanic American

\_\_\_\_\_ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

\_\_\_\_\_ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

\_\_\_\_\_ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

\_\_\_\_\_ Individual/concern, other than one of the preceding.

**(c) Definitions.**

“Small business concern,” as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

“Woman-owned small business concern,” as used in this provision, means a small business concern--

(1) Which is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

**(d) Notice.** (1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm’s status as a small or small disadvantaged business concern in order to obtain a contract to be awarded under the preference programs

established pursuant to sections 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

- (i) Be punished by imposition of fine, imprisonment, or both;
  - (ii) Be subject to administrative remedies, including suspension and debarment; and
  - (iii) Be ineligible for participation in programs conducted under the authority of the Act.
- (End of provision)

#### **9. EQUAL LOW BIDS (OCT 1995) FAR 52.219-2**

(a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

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(c) Failure to identify the labor surplus areas as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

(End of provision)

#### **10. SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (JAN 1997) FAR 52.219-19**

(a) **Definition.** "Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the standard industrial classification code assigned to a contracting opportunity.

(b) **(Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.)** The Offeror [ ] is, [ ] is not an emerging small business.

(c) **(Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)** Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts - see paragraph 11(a) (2) Small Business Program Representations).

Number of Employees	<b>(Construction Solicitations)</b> Avg. Annual Gross Revenues
_____ 50 or fewer	_____ \$1 million or less
_____ 51 - 100	_____ \$1,000,001 - \$2 million
_____ 101 -250	_____ \$2,000,001 - \$3.5 million
_____ 251 - 500	_____ \$3,500,001 - \$5 million
_____ 501 - 750	_____ \$5,000,001 - \$10 million
_____ 751 - 1,000	_____ \$10,000,001 - \$17 million
_____ Over 1,000	_____ Over \$17 million

(End of provision)

**11. PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999) FAR 52.222-22**

The offeror represents that--

(a) It [ ] has [ ] has not, participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation;

(b) It [ ] has, [ ] has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of Provision)

**12. CLEAN AIR AND WATER CERTIFICATION (APR 1984) FAR 52.223-1**

The Offeror certifies that--

(a) Any facility to be used in the performance of this proposed contract [ ] is, [ ] is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the EPA, indicating that any facility that the Offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

(End of Provision)

**13. CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 1996)  
FAR 52.223-13**

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8,1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facilities is exempt for at least one of the following reasons: *(Check each block that is applicable.)*

- (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);
- (ii) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);
- (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);
- (iv) The facility does not fall within the Standard Industrial Classification Code (SIC) designations 20 through 39 as set forth in section 19.102 of the Federal Acquisition Regulation; or

(v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of provision)

(End of Section 00605)

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215.408(1))		
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## SECTION 00700

## CONTRACT CLAUSES

## 1 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at these addresses:

<http://www.hnd.usace.army.mil/techinfo/index.htm>

## 2 52.3-4001 INFORMATION REGARDING BID, PERFORMANCE, AND PAYMENT BONDS

(a) Bid Bonds: (Applicable only if bid is \$25,000 or greater.) Each bidder shall submit with its bid a Bid Bond (Standard Form 24) with good and sufficient surety or sureties acceptable to the Government, or other security as provided in Section I - "BID BOND", in the form of twenty percent (20%) of the bid price or \$3,000,000, whichever is less.

The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may expressed in dollars and cents.

(b) Performance and Payment Bonds: (Applicable only if the contract is \$25,000 or greater.) Within 10 calendar days after award, a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A), each with good and sufficient surety or sureties acceptable to the Government, shall be furnished. The penal sums of such bonds will be as follows:

(1) Performance Bond: The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price. The performance bond shall specifically provide coverage for taxes imposed by the United States which are collected, deducted, or withheld from wages paid by the Contractor in carrying out the contract with respect to which such bond is furnished.

(2) Payment Bond:

(i) When the contract price is 1,000,000 or less, the penal sum will be fifty (50%) of the contract price.

(ii) When the contract price is in excess of \$1,000,000 but less than \$5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(iii) When the contract price is more than \$5,000,000, the penal sum shall be \$2,500,000.

- 3 52.201-7000  
CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)  
(Reference 01.602-70)
- 4 52.202-1 IDEFINITIONS (OCT 1995)--ALTERNATE I (APR 1984)  
(Reference 2.201)
- 5 52.203-3 GRATUITIES (APR 1984)  
(Reference 3.202)
- 6 52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)  
(Reference 3.404)

- 7 52.203-7 ANTI-KICKBACK PROCEDURES (JUL 1995)  
(Reference 3.502-3)
- 8 52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN  
1997)  
(Reference 3.104-9(b))
- 9 52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL  
TRANSACTIONS (JUN  
1997)  
(Reference 3.808(b))
- 10 52.204-1 APPROVAL OF CONTRACT (DEC 1989)

This contract is subject to the written approval of Contracting Officer  
and shall not be binding until so approved.

(End of clause)

- 11 52.203-7001  
SPECIAL PROHIBITION ON EMPLOYMENT (JUN 1997)  
(Reference 03.570-5)
- 12 52.203-7002  
DISPLAY OF DOD HOTLINE POSTER (DEC 1991)  
(Reference 03.7002)
- 13 52.204-2 SECURITY REQUIREMENTS (AUG 1996)  
(Reference 4.404(a))
- 14 52.204-4 PRINTING/COPYING DOUBLE-SIDED ON RECYCLED PAPER (JUN 1996)  
(Reference 4.304)
- 15 52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH  
CONTRACTORS  
DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995)  
(Reference 9.409(b))
- 16 52.211-1 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF  
FEDERAL  
SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (JUN  
1997)  
(Reference 11.204(a))
- 17 52.211-2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF  
SPECIFICATIONS  
AND STANDARDS (DODISS) (JUN 1997)  
(Reference 11.204(b))
- 18 52.211-16 VARIATION IN QUANTITY (APR 1984)  
(Reference 11.703(a))
- 19 NOT USED.
- 20 52.228-7004  
BONDS OR OTHER SECURITY (DEC 1991)  
(Reference 28.170)
- 21 NOT USED.
- 22 NOT USED.
- 23 NOT USED.
- 24 52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (JAN 1999)  
(Reference 19.708(a))
- 25 NOT USED.
- 26 52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996)  
(Reference 19.508(e))
- 27 NOT USED.

28 52.222-1 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997)  
(Reference 22.103-5(a))

29 52.222-3 CONVICT LABOR (AUG 1996)  
(Reference 22.202)

30 52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME  
COMPENSATION  
(JUL 1995)  
(Reference 22.305)

31 52.222-6 DAVIS-BACON ACT (FEB 1995)  
(Reference 22.407(a)(1))

32 52.222-7 WITHHOLDING OF FUNDS (FEB 1988)  
(Reference 22.407(a)(2))

33 52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)  
(Reference 22.407(a)(3))

34 52.222-9 APPRENTICES AND TRAINEES (FEB 1988)  
(Reference 22.407(a)(4))

35 52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)  
(Reference 22.407(a)(5))

36 52.222-11 SUBCONTRACTS (LABOR STANDARDS) (FEB 1988)  
(Reference 22.407(a)(6))

37 52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)  
(Reference 22.407(a)(7))

38 52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB  
1988)  
(Reference 22.407(a)(8))

39 52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)  
(Reference 22.407(a)(9))

40 52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)  
(Reference 22.407(a)(1))

41 52.222-26 EQUAL OPPORTUNITY (APR 1984)  
(Reference 22.810(e))

42 52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION  
(APR 1984)  
(Reference 22.810(f))

43 52.222-35 AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE  
VIETNAM  
ERA (APR 1998)  
(Reference 22.1308)

44 52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)  
(Reference 22.1408(a))

45 52.222-37 EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE  
VIETNAM ERA (JAN 1999)  
(Reference 22.1308(b))

46 52.223-2 CLEAN AIR AND WATER (APR 1984)  
(Reference 23.105(b))

47 52.223-6 DRUG-FREE WORKPLACE (JAN 1997)  
(Reference 23.505(b))

48 52.223-7004  
DRUG-FREE WORK FORCE (SEP 1988)  
(Reference 23.570-4)

49 52.225-5 BUY AMERICAN ACT--CONSTRUCTION MATERIALS (JUN 1997)  
(Reference 25.207(a))

50 NOT USED.

51 52.225-11 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (OCT 1996)  
(Reference 25.702)

52 52.225-7002  
QUALIFYING COUNTRY SOURCES AS SUBCONTRACTORS (DEC 1991)  
(Reference 25.109-70(a))

53 52.225-7003

INFORMATION FOR DUTY-FREE ENTRY EVALUATION (MAR 1998)  
(Reference 25.605-70(d))

54 52.225-7031  
SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992)  
(Reference 25.770-5)

55 52.227-1  
AUTHORIZATION AND CONSENT (JUL 1995)  
(Reference 27.201-2(a))

56 52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT  
INFRINGEMENT  
(AUG 1996)  
(Reference 27.202-2)

57 52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)  
(Reference 27.203-5)

58 52.227-7003  
TERMINATION (AUG 1984)  
(Reference 27.7009-2(c))

59 52.227-7018  
RIGHTS IN NONCOMMERCIAL TECHNICAL DATA AND COMPUTER SOFTWARE--  
SMALL  
BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM (JUN 1995)  
(Reference 27.7104(a))

60 NOT USED.

61 52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)  
(Reference 28.106-4(a))

62 52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997)  
(Reference 28.310)

63 52.228-11 PLEDGES OF ASSETS (FEB 1992)  
(Reference 28.203-6)

64 52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)  
(Reference 29.401-3)

65 52.231-7000  
SUPPLEMENTAL COST PRINCIPLES (DEC 1991)  
(Reference 31.100-70)

66 52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997)  
(Reference 32.111(a)(5))

67 52.232-17 INTEREST (JUN 1996)  
(Reference 32.617(a)&())

68 52.232-23I ASSIGNMENT OF CLAIMS (JAN 1986) (Alternate I) (Apr 1984)  
(Reference 32.806(a)(1))

69 52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JUN 1997)  
(Reference 32.908(b))

70 52.233-1 DISPUTES (DEC 1998)  
(Reference 33.215)

71 NOT USED

72 52.236-1 PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984)  
(Reference 36.501(b))

73 52.236-2 DIFFERING SITE CONDITIONS (APR 1984)  
(Reference 36.502)

74 52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)  
(Reference 36.503)

75 52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)  
(Reference 36.505)

76 52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)  
(Reference 36.506)

77 52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)  
(Reference 36.507)

78 52.236-8 OTHER CONTRACTS (APR 1984)  
(Reference 36.508)

- 79 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT,  
UTILITIES, AND  
IMPROVEMENTS (APR 1984)  
(Reference 36.509)
- 80 52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)  
(Reference 36.510)
- 81 52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)  
(Reference 36.511)
- 82 52.236-12 CLEANING UP (APR 1984)  
(Reference 36.512)
- 83 52.236-13 ACCIDENT PREVENTION (NOV 1991)  
(Reference 36.513(a))
- 84 52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)  
(Reference 36.515)
- 85 52.236-17 LAYOUT OF WORK (APR 1984)  
(Reference 36.517)
- 86 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)  
(Reference 36.521)
- 87 52.236-7000  
MODIFICATION PROPOSALS--PRICE BREAKDOWN (DEC 1991)  
(Reference 36.570(a))
- 88 52.236-7004 PAYMENT FOR MOBILIZATION AND DEMOBILIZATION (DEC 1991)

(a) The Government will pay all costs for the mobilization and demobilization of all of the Contractor's plant and equipment at the contract lump sum price for this item.

(1) 60 percent of the lump sum price upon completion of the Contractor's mobilization at the work site.

(2) The remaining 40 percent upon completion of demobilization.

(b) The Contracting Officer may require the Contractor to furnish cost data to justify this portion of the bid if the Contracting Officer believes that the percentages in paragraphs (a)(1) and (2) of this clause do not bear a reasonable relation to the cost of the work in this contract.

(1) Failure to justify such price to the satisfaction of the Contracting Officer will result in payment, as determined by the Contracting Officer, of--

(i) Actual mobilization costs at completion of mobilization;

(ii) Actual demobilization costs at completion of demobilization; and

(iii) The remainder of this item in the final payment under this contract.

(2) The Contracting Officer's determination of the actual costs in paragraph (b)(1) of this clause is not subject to appeal.

(End of clause)

- 89 52.236-7001 CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (DEC 1991)

(a) The Government--

(1) Will provide the Contractor, without charge, five sets (five unless otherwise specified) of large-scale contract drawings and specifications except publications incorporated into the technical provisions by reference;

(2) Will furnish additional sets on request, for the cost of reproduction; and

(3) May, at its option, furnish the Contractor one set of reproducible, or half-size drawings, in lieu of the drawings in paragraph (a)(1) of this clause.

(b) The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the

work;

(3) Promptly notify the Contracting Officer of any discrepancies; and

(4) Be responsible for any errors which might have been avoided by complying with this paragraph (b).

(c) Large scale drawings shall, in general, govern small scale drawings. Figures marked on drawings shall, in general, be followed in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

Title	File	and	Drawing No.
See 0800-9	page 0800-3.		
	(End of clause)		

- 90 52.236-7005 AIRFIELD SAFETY PRECAUTIONS (DEC 1991)  
(Reference 36.570(b)(3))
- 91 52.242-13 BANKRUPTCY (JUL 1995)  
(Reference 42.903)
- 92 52.243-4 CHANGES (AUG 1987)  
(Reference 43.205(d))
- 93 52.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)  
(Reference 43.205-71)
- 94 52.244-1 SUBCONTRACTS (FIXED-PRICE CONTRACTS) (OCT 1997)  
(Reference 44.204)
- 95 52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS AND COMMERCIAL COMPONENTS  
(APR 1998)  
(Reference 44.403)
- 96 52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989)  
(Reference 45.106(b)(1))
- 97 52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)  
(Reference 46.312)
- 98 52.246-21 I WARRANTY OF CONSTRUCTION (MAR 1994)--ALTERNATE I (APR 1984)  
(Reference 46.710(e)(2))
- 99 52.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (NOV 1995)  
(Reference 47.573(b))
- 100 52.247-7024 NOTIFICATION OF TRANSPORTATION OF SUPPLIES BY SEA (NOV 1995)  
(Reference 47.573(c))
- 101 52.248-3 VALUE ENGINEERING--CONSTRUCTION (MAR 1989)  
(Reference 48.202)
- 102 52.249-2 ITERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE)  
(SEP 1996)--  
ALTERNATE I (SEP 1996)  
(Reference 49.502(b)(1))
- 103 52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)  
(Reference 49.504(c)(1))
- 104 52.252-6 AUTHORIZED DEVIATIONS IN CLAUSES (APR 1984)

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is

indicated by the addition of "(DEVIATION)" after the date of the clause.

(b) The use in this solicitation or contract of any N/A (48 CFR N/A ) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of clause)

(NM)

- 105 52.253-1 COMPUTER GENERATED FORMS (JAN 1991)  
(Reference 53.111)
- 106 52.214-35 SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991)  
(Reference 14.201-6y &)
- 107 52.214-34 SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991)  
(Reference 14.201-6x &)
- 108 52.3-4002 APPLICABILITY OF COMPLETE WAGE RATE DECISION

Read the following in conjunction with the Wage Rates:

In addition to the wages rates in this solicitation, the complete decision of the Secretary of Labor contains wage rates for other classes of laborers and mechanics. Because it does not appear that the work called for by this solicitation will require the use of such other classes, the wage rates applicable to them have not been reprinted herein. However, if any such classes of laborers or mechanics actually are employed to perform work under the contract resulting from this solicitation, payment will be required as specified in the clauses entitled "Davis-Bacon Act" at Wage rates contained in the completed decision of the Secretary of Labor. Offerors desiring the complete decision may request it from the Contracting Officer.

- 109 52.0-4000 EFARS 52.202-10001 DEFINITIONS.

(a) The term "head of the agency" or "Secretary" as used herein means the Secretary of the Army; and the term "his duly authorized representative" means the Chief of Engineers, Department of the Army, or an individual or board designated by him.

(b) The agency board of contract appeals having jurisdiction over all appeals from final decisions of the Contracting Officer under the Contract Disputes Act of 1978 is the Corps of Engineers Board of Contract Appeals, Office of the Chief of Engineers, Pulaski Building, 20 Massachusetts Avenue, N.W., Washington, D.C. 20314-1000.

- 110 52.242-7000 POSTAWARD CONFERENCE (DEC 1991)  
(Reference 42.570)

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## SECTION 00800

### SPECIAL CONTRACT REQUIREMENTS

2 January 1996

1. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984)

a. FAR 52.211-10. The Contractor shall be required to commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, prosecute said work diligently, and complete the entire work ready for use not later than 540 calendar days after date of receipt of notice to proceed. The time stated for completion shall include as-built drawings, O&M manuals, operational tests/reports/training/instructions, equipment lists, and final cleanup of the premises.

b. Location: The project is located at Fort Dix, New Jersey.

c. The Contractor shall furnish all labor, materials, equipment, and services (except those furnished by the Government) for the following work: Ammunition Supply Point and site improvements.

d. All work shall be in accordance with the drawings and specifications or instructions attached hereto and made a part thereof, or to be furnished hereafter by the Contracting Officer and subject, in every detail, to his supervision, direction, and instructions.

e. Magnitude of Construction Project: The estimated value of the proposed work is between \$5,000,000 TO \$10,000,000.

### 2. LIQUIDATED DAMAGES – CONSTRUCTION

a. If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of \$365.00 for each day of delay.

b. If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

c. If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

### 3. EQUAL OPPORTUNITY PREAWARD CLEARANCE OF SUBCONTRACTORS (APR 1984)

Notwithstanding the clause of this contract entitled “Subcontracts”, the Contractor shall not enter into a first-tier subcontract for an estimated or actual amount of \$1 million or more without obtaining in writing from the Contracting Officer a clearance that the proposed subcontractor is in compliance with the equal opportunity requirements and therefore is eligible for award. (FAR 52.222-28)

#### 4. INSURANCE – WORK ON A GOVERNMENT INSTALLATION

a. The Contractor shall procure and maintain during the entire period of his performance under this contract the following minimum insurance:

(1) General Liability Insurance (Comprehensive form of policy):

Bodily Injury Liability - \$500,000 per occurrence.

(2) Automobile Liability Insurance (Comprehensive form of policy):

Bodily Injury Liability - \$200,000 per person and \$500,000 per accident.

Property Damage Liability - \$20,000 per accident.

(3) Workmen’s Compensation and Employer’s Liability Insurance:

Compliance with applicable workmen’s compensation and occupational disease statutes is required. Employer’s liability coverage in the minimum amount of \$100,000 is also required.

b. Prior to the commencement of work hereunder, the Contractor shall furnish to the Contracting Officer a certificate or statement of the above required insurance. The policies evidencing required insurance shall contain an endorsement to the effect that cancellation or any material change in the policies adversely affecting the interests of the Government in such insurance shall not be effective for such a period as may be prescribed by the laws of the State in which this contract is to be performed and in no event less than thirty (30) days after written notice thereof to the Contracting Officer.

c. The Contractor agrees to insert the substances of this clause, including this paragraph c., in all subcontracts hereunder.

#### 5. PERFORMANCE OF WORK BY THE CONTRACTOR (1984 APR)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least twenty (20) percent of the total amount of work to be performed under the contract. This percentage may be reduced by supplemental agreement to this

contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government. (FAR 52.236-1)

## 6. CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in 4 copies. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certification apply. Copies of laboratory tests reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfying material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements. (ECI 7-670.3)

## 7. IMPLEMENTING GUARANTEES

At any time subsequent to the acceptance by the Government of a completed installation under this contract, which installation is required to be covered by a specific guarantee under the terms of the various sections in the TECHNICAL PROVISIONS, the Base Commander will be an authorized party for the purpose of implementing the provisions of such guarantees in behalf of the Government.

## 8. BID GUARANTEE

See Contract clause entitled BID GUARANTEE in Section 00100 INSTRUCTIONS FOR SEALED BID CONTRACTS

## 9. CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS

See contract clause entitled CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS in Section 00700 CONTRACT CLAUSES. For a listing of the contract drawings see drawing Sheet X1.2.

## 10. RECORD DRAWINGS

a. General: The Contractor will maintain as-built drawings during the construction and will develop final record drawings at the completion of individual facilities.

b. Computer-Aided Drafting (CAD): Microstation CADD files are available for the project and in addition to all other requirements indicated herein, the Contractor shall be required to update the Computer-Aided Drafting (CAD) record using Microstation

CADD only for the project. If available the CAD record will be presented to the Contractor in addition to the mylar reproducible drawings after the approval of progress prints as indicated in paragraph "Preliminary Submittal", below. The Contractor will update the CAD record identical to the final as-built drawings, and will return the CAD record to the Contracting Officer's representatives with the same requirements and late penalty as indicated in paragraph "Final Requirements", below. Scanned drawings will not be acceptable. All other requirements indicated herein will still apply. The Contractor may use the updated CAD record to print blue-line or mylar drawings as required.

c. Progress As-built Prints: The Contractor shall mark up one set of paper prints to Show as-built construction conditions. These as-built prints shall be kept current and available on the job site at all times. All changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accordingly and neatly recorded as they occur by means of details and notes. The as-built prints will be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. The prints shall show the following information, but not limited thereto:

(1) The location and description of any utility lines, valves, or other installations of any kind within the construction area. The location includes dimensions to permanent features.

(2) The location and dimensions of any changes with the building and structure.

(3) Correct grade or alignment of roads, structures or utilities if any changes were made from the contract plans.

(4) Correct elevations if changes were made in site grading

(5) Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including but not limited to fabricated, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

(6) The topography and grades of all drainage installed or affected as part of the project construction.

(7) All changes, which result from contract modifications.

(8) Where contract drawings or specifications allow options, only the option selected for construction shall be shown on the as-built prints.

(9) All amendments to the contract drawings issued during the solicitation period shall be posted on the as-built drawings.

d. Preliminary Submittal: The Contractor shall prepare two copies of progress prints and these shall be delivered to the Contracting Officer at the time of final inspection of individual facilities for his review and approval. These as-built prints shall be neat, legible and accurate. Upon approval, one copy of the as-built prints will be returned to the Contractor for use in preparation of final as-built drawings. Upon review, if the drawings are found to contain errors and/or omission, they shall be returned to the Contractor for corrections and return of the as-built prints to the Contracting Officer within ten (10) calendar days.

e. Record Drawing Preparation: After approval of the progress as-built prints, the mylar drawings shall be modified as may be necessary to correctly show all the features of the project as it has been constructed by bringing the contract set into agreement with the approved as-built prints, adding such additional drawings as may be necessary. The Contractor shall be responsible for the protection and safety thereof until returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at his expense.

(1) Only personnel proficient in the preparation of engineering drawings to standards satisfactory and acceptable to the Government shall be employed to modify the mylar reproduction drawings or prepare additional new drawings. All additions and corrections to the contract drawings shall be neat, clean and legible, and shall match the adjacent line work and/or lettering being annotated in type, density, size and style. All drafting work shall be done using the same medium (pencil, plastic lead or ink) that was employed on the original contract drawings and with graphic lead on paper base material. The Contracting Officer will review all record drawings for accuracy and conformance to the above specified drafting standards. The Contractor shall make all corrections, changes, additions and deleting required to meet these standards. The title block to be used for any new as-built drawings shall be similar to that used on the original contract drawings.

(2) When final revisions have been completed, each drawing shall be lettered or stamped with the words "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in lettering at least 3/16" high. All original contract drawings shall be marked either "s-Built" drawing denoting no revision on the sheet or "Revised As-Built" denoting one or more revisions. All revisions to the original contract drawings will be dated in the revision block.

f. Final Requirements: After receipt by the Contractor of the approved as-built prints and the mylar reproducible drawings, the Contractor will make final record drawings submitted within 30 days. The submittal shall consist of the completed record drawings, two blue line prints of these drawings and the return of the approved marked-up as-built prints. They shall be complete in all details. All paper prints and reproducible

drawings will become property of the Government upon final approval. Failure to submit as-built drawings and final record drawings as required herein shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of the final record drawings shall be accomplished before final payment is made to the Contractor.

g. Beneficial Occupancy Drawings: If the Government accepts beneficial occupancy of a facility, and the Contractor is unable to provide the final record drawings within 45 days after the date of beneficial occupancy, the Contractor shall provide paper sepias for that facility. The paper sepias shall incorporate all changes to as-built drawings made up to the time of beneficial occupancy. Contractor is still obligated to comply with “Final Requirements” paragraph above.

h. Payment: No separate payment will be made for the as-built and record drawings required under this contract whether or not CAD record is updated, and all costs in connection therewith shall be considered a subsidiary obligation of the Contractor.

## 11. DESIGNATION OF PROPERTY ADMINISTRATOR

The Chief, Property and Accounting Section, U.S. Army Engineer District, New York, Federal Building, 26 Federal Plaza, New York, N.Y. 10278-0090 is designated as Property Administrator, in connection with this contract.

## 12. PHYSICAL DATA

Information and data furnished or referred to below are furnished for the Contractor’s information. However, it is expressly understood that the Government will not be responsible for any interpretation or conclusion drawn therefrom by the Contractor. (FAR 52.236-4)

a. Weather Conditions: Climatological data determined from records of the U.S. Weather Bureau Station,

Mean Annual Temperature: 35 degrees F

Mean Annual Precipitation: 40 inches

See also paragraph entitled TIME EXTENSIONS FOR UNUSUALLY SEVER WEATHER.

b. Transportation Facilities:

(1) Highways and Roads: Roads within the military reservation proposed to be used by the Contractor, shall be subject to prior approval of the Contracting Officer and such roads, if used, shall be maintained throughout construction and shall be restored to as good condition as existed prior to their use. Any such temporary construction shall

be restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

### 13 PRICING OF ADJUSTMENTS

When costs are a factor in any determination of a contract price adjustment pursuant to the Changes clause or any other clause of this contract, such costs shall be in accordance with Part 31 of the Federal Acquisition Regulation and DFARS 52.215-7000 (APR 1985) as follows: In determining whether a pricing adjustment is expected to exceed \$100,000, the term "pricing adjustment" shall mean "the aggregate increases and /or decreases in cost plus applicable profits."

### 14 PAYMENT FOR MATERIALS DELIVERED OFF-SITE

Pursuant to the Contract Clause in this contract titled "Payment Under Fixed-Price Construction Contracts", materials delivered to the Contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the Contract Clauses are fulfilled. Payment for items delivered to locations other than the work site will be limited to those materials which have been approved, if required by the technical provisions; those materials which have been fabricated to the point where they are identifiable to an item of work required under this contract. Such payment will be made only after receipt of paid or receipted invoices or invoices with cancelled check showing title to the items in the prime contractor and including the value of materials and labor incorporated into the item.

### 15 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

a. Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractors at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region 1. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiation shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

(\* This manual can be ordered from the Government Printing office by calling telephone number (202) 783-3238. There is a charge for the manual.)

b. Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36 substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-

leaseback arrangements will be determined using the schedule except that rental costs leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

c. When actual equipment costs are proposed and the total amount of the pricing action is over \$25,000, cost or pricing data shall be submitted on Standard Form 1411, "Contract Pricing Proposal Cover Sheet." By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

## 16 ALTERATIONS IN CONTRACT (APR 1984)

Portions of this contract are altered as follows:

Add the following sentence to paragraph "g" of basic contract clause, SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (1984 APR):

"Upon completing the work under this contract, the Contractor shall furnish a complete set of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the equipment is completed and accepted." Alt.1 (APR 1984) (FAR 52.236-21) (7-602.54 (b) (1) OCT 1976)

## 17 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984)

a. The Government shall make all reasonable amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

b. The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all temporary connections, distribution lines, meters and associated paraphernalia. (FAR 52.235-14)

18 SALVAGE MATERIALS AND EQUIPMENT

The Contractor shall maintain adequate property control records for all materials or equipment specified to be salvaged. These records may be in accordance with the Contractor’s system of property control, if approved by the property administrator. The Contractor shall be responsible for the adequate storage and protection of all salvaged materials and equipment and shall replace, at no cost to the Government, all salvage materials and equipment which are broken or damaged during salvage operations as the result of his negligence, or while in his care. (DoD FAR Supplement 52.236-7005)

19. IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY (APR 1984)

a. The Government will furnish to the Contractor the property identified in the Schedule to be incorporated or installed into the work or used in performing the contract. The listed property will be furnished f.o.b. railroad cars at the place specified in the contract Schedule or f.o.b. truck at the project site. The Contractor is required to accept delivery, pay any demurrage or detention charges, and unload and transport the property to the job site at its own expense. When the property is delivered, the Contractor shall verify its quantity and condition and acknowledge receipt in writing to the Contracting Officer. The Contractor shall also report in writing to the Contracting Officer within 24 hours of delivery any damage to or shortage of the property as received. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated in this contract.

b. Each item of property to be furnished under this clause shall be identified in the Schedule by quantity, item and description. (FAR 52.245-3)

<u>Item No.</u>	<u>Description</u>	<u>Quantity</u>
	Bronze Minuteman Plaque	1

20 CONSTRUCTION PROJECT SIGNS

The Contractor shall construct two signs; one for project identification and the other to show on-the-job safety performance.

a. Sample sign drawings together with mounting and fabrication details are provided at the end of this section. The signs shall be erected as soon as possible and within 15 calendar days after the date of Notice to Proceed.

b. The two signs are to be displayed side by side and mounted for reading by passing viewers. Exact placement location will be designated by the Contracting Officer.

c. Panels are fabricated using HDO (High-Density Overlay) plywood with dimensional lumber uprights and bracing. The sign faces are non-reflective vinyl.

d. All legends are to be die-cut or computer-out in the sizes and type-faces specified and applied to the white panel background following the graphic formats shown on the attached sheets. The Communications Red panel on the left side of the construction project sign with Corps signature (reverse version) is screen printed onto the white background.

e. No separate payment will be made for erecting and maintaining the signs and all costs in connection therewith will be considered the obligation of the Contractor. Upon completion of the project, the Contractor shall remove the signs from the work area.

## 21 LABOR SURPLUS AREA EXPENDITURE REQUIREMENTS (JUL 1978)

a. The site of the construction work is located in an area determined by the Secretary of Labor to be a Labor surplus Area. Accordingly the Contractor hereby agrees to perform a substantial portion of the contract work in this or in any other labor surplus area. "Substantial portion" means the aggregate costs that will be incurred by the Contractor and his first-tier subcontractors and suppliers, on account of manufacturing, production, or services performed in this or any labor surplus area, and the costs that will be incurred by second-tier and lower-tier subcontractors on the construction site will exceed fifty percent (50%) of the price of this contract.

b. Upon request, the Contractor shall furnish to the Contracting Officer data to substantiate that this obligation is satisfied.

c. The Contracting Officer will furnish upon request a list of labor surplus areas.

## 22 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

1. This provision specifies the procedure for determination of time extension for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

2. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations.

The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

**MONTHLY ANTICIPATED ADVERSE WEATHER DELAY  
WORK DAYS BASED ON (5) DAY WORK WEEK**

<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
(09)	(10)	(09)	(07)	(06)	(05)	(04)	(04)	(05)	(06)	(06)	(08)

3. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled workday. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph 2 above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)". (ER 415-1-5) (31 Oct 89)

**23 SCHEDULING AND DETERMINATION OF PROGRESS**

Pursuant to the contract clause, SCHEDULES FOR CONSTRUCTION CONTRACTS, the Contractor shall prepare and submit for approval a practicable project schedule. The type of schedule and detailed requirements as well as timing of this submittal shall be as specified in specification section 01310 'PROJECT SCHEDULE'.

This schedule will be the medium through which the timeliness of the Contractor's construction effort is appraised. When changes are authorized that result in contract time extensions, Contractor shall submit a modified schedule for approval by the Contracting Officer.

The terms of Contract Clause, SCHEDULING FOR CONSTRUCTION CONTRACTS, with reference to overtime, extra shifts, etc., may be invoked when the Contractor fails to start or complete work features or portions of same by the time indicated by the milestones dates on the approved project schedule, or when it is apparent to the Contracting Officer from the Contractor's actual progress that these dates will not be met.

Neither on the project schedule as originally submitted nor on any updated periodic schedules which the Contractor is required to prepare and submit, shall be actual progress to be entered include or reflect any materials which even though on the site, are not yet installed or incorporated in the work. For payment purposes only, an allowance will be made by the Contracting Officer of up to 100 percent of the invoiced cost of

materials or equipment delivered to the site but not incorporated into the construction, pursuant to Contract Clause, PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS. The making of such an allowance will be contingent upon a determination by the Contracting Officer that the Contractor's compliance with the quality control requirements of the contract is more than satisfactory.

#### 24 IDENTIFICATION OF EMPLOYEES

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work to display such identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon the release of any employees. When required by the Contracting Officer, the Contractor shall obtain and submit finger-prints of all persons employed or to be employed on the project. (DOD FAR Supplement 52.236-7007)

#### 25 NOT USED.

#### 26 NOT USED

#### 27. NOT USED

#### 28. NOT USED

#### 29 MISPLACED MATERIAL

Should the Contractor, during the progress of the work, lose, dump, throw overboard, Sink, or misplace any material, plant, machinery, or appliance, which in the opinion of the Contracting Officer may be dangerous to or obstruct navigation, the Contractor shall recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such obstructions, to the Contracting Officer or inspector, and when required shall mark or buoy such obstructions until the same are removed. Should he refuse, neglect, or delay compliance with the above requirements, such obstructions may be removed by the Contracting Officer, and the cost of such removal may be deducted from any money due or to become due the Contractor, or may be recovered under his bond. The liability of the Contractor for the removal of a vessel wrecked or sunk without fault or negligence shall be limited to that provided in Sections 15,19, and 20 of the River and Harbor Act of March 3, 1899. (33 U.S.C. 410 et seq.) (DOD FAR Supplement 52.236-7006)

#### 30. SUPERINTENDENCE OF SUBCONTRACTORS (JAN 1965)

a. The Contractor shall be required to furnish the following, in addition to the superintendence required by the Contract Clause titled, 'SUPERINTENDENCE BY THE CONTRACTOR.'

(1) If more than 50% and less than 705 of the value of the contract work is subcontracted, one superintendent shall be provided at the site and on the Contractor's payroll to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

(2) If 70% or more of the value of the work is subcontracted, the Contractor shall be required to furnish two such superintendents to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

b. If the Contracting Officer, at any time after 50% of the subcontracted work has been completed, finds that satisfactory requirement is being made, he may waive all or part of the above requirement for additional superintendence subject to the right of the Contracting Officer to reinstate such requirement if at any time during the progress of the remaining work he finds that satisfactory progress is not being made.  
(DOD FAR Supplement 52.236-7008)

### 31 PROCEDURES FOR SUBMISSION AND PAYMENT OF ALL CONTRACT PAYMENTS

In addition to the requirements contained in the Contract Clause entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS" and to implement the requirements of the Prompt Payment Act Amendments of 1988, P.L. 100-496, the following shall apply to all payments made under this contract:

a. At the time of submission of the progress chart, the Contractor shall submit for approval by the Contracting officer or his authorized representative a breakdown of the contract work which shall be to the degree of detail required by the Contracting Officer, or his representative, to effect reasonable progress payments. The Contracting Officer, or his representative, shall review this breakdown within 30 calendar days after receipt and either advise the Contractor that it is approved or disapproved, and if disapproved the reasons for disapproval. Only after the breakdown is approved shall any payment invoice be accepted from the Contractor and any payment made to him. The Contracting Officer can determine if it is in the best interest of the Government to make payment without an approved breakdown; however, in no case shall more than 10% of the contract amount be paid unless the breakdown is approved.

b. The Contractor shall submit his request for payment by submission of a proper invoice to the office or person(s) designated in subparagraph c. For purposes of payment a "proper invoice" is defined as the following:

(1) An estimate of the work completed in accordance with the approved breakdown indicating the percentage of work of each item and the associated costs.

(2) A properly completed Eng Form 93 and 93a (where required).

(3) All contractual submissions indicated elsewhere in this contract to be submitted with payment, such as updated progress schedules, updated submittal registers, etc.

(4) The following certification executed by a responsible official of the organization authorized to bind the firm. A “responsible official” would be a corporate office, partner, or owner, in the case of a sole proprietorship.

I hereby certify, to the best of my knowledge and belief, that –

(a) The amounts requested are only for performance in accordance with the specifications, terms and conditions of the contract;

(b) Payments to subcontractors and suppliers have been made from previous payments received under the contract and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract requirements and the requirements of Chapter 39 of Title 31, United States Code; and

(c) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.

(d) All required prime and subcontractor payrolls have been submitted.

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Date)

c. The Government shall designate the office or person(s) who shall first receive the invoice submissions and the Contractor shall be so notified at the pre-construction conference. In addition to the designated Project Engineer, the Contractor shall at the same time submit one copy of the detailed breakdown and the Eng Form 93 and 93a Form to the Area Engineer.

d. The Government representative shall return any request for payment which is deemed defective within 7 days of receipt and shall specify the defects. If the defect concerns a disagreement as to the amount of work performed and or the amount of the

payment being submitted, the Government and the Contractor's representative should meet to resolve the difference and reach agreement. Upon agreement, the Contractor shall submit a new breakdown and Eng Form 93 (and 93a) and any other submissions requiring correction. These will be incorporated with the previous submittal and will then constitute a proper invoice.

e. If agreement cannot be reached, the Government shall determine the proper amount per Contract Clause, PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS and process the payment accordingly. In this event, a "proper invoice" for Prompt Payment Act purposes will not have been submitted to the Government.

f. The Government shall pay the Contractor in accordance with the following time frames:

(1) Progress Payments . From the date a "proper invoice" is received, in accordance with subparagraphs b and d of this clause, the Government will issue a check with 14 calendar days.

(2) Reduction in Retainage Payment. If during the course of the contract, a reduction in retainage payment is required, the Government shall issue a check within 14 calendar days after the approval of the release to the Contractor by the Contracting Officer or his authorized representative.

(3) Final Payment. A final payment request shall not be considered valid until the Contractor has fulfilled all contract requirements including all administrative items, payrolls, warranties, etc. and has submitted a release of claims. When the Contractor has fulfilled all contract requirements and a "proper invoice" has been submitted, the Government shall issue a check within 14 days from the date of acceptance of the project by the Contracting Officer.

## 32 VERIFICATION OF SMALL BUSINESS UTILIZATION

a. This clause is applicable to small business concerns whose contracts exceed \$1,000,000.

b. In accordance with the clause at FAR 52.219-8, entitled UTILIZATION OF SMALL BUSINESS CONCERNS AND DISADVANTAGED BUSINESS CONCERNS, in effect on the date of this contract, the Contracting Office may survey the extent of small and small disadvantaged business utilization under this contract. The Contractor may be required to report to the Contracting Officer statistical data on the number and dollars amounts of subcontracting awards with small business and small disadvantaged businesses.

c. As appropriate, the Contracting Officer may require one or more follow-up reports to the initial report.

d. The Contractor agrees to insert this clause in any subcontract that may exceed \$1,000,000, including this subparagraph d.

33 HAZARDOUS MATERIAL IDENTIFICATION & MATERIAL SAFETY DATA  
(NOV 1991)

a. Hazardous material, as used in this clause, includes any material defined as hazardous under the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract.)

b. The offeror must list any hazardous material, as defined in paragraph a of this clause, to be delivered under this contract. The hazardous material shall be properly identified and include any applicable identification number, such as National Stock Number or Special Item Number. This information shall also be included on the Material Safety Data Sheet submitted under this contract.

Material (if none, insert NONE)

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Identification No.

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c. The apparently successful offeror, by acceptance of the contract, certifies that the list in paragraph b of this clause is complete. This list must be updated during performance of the contract whenever the Contractor determines that any other material to be delivered under this contract is hazardous.

d. The apparently successful offeror agrees to submit, for each item as required prior to award, a Material Safety Data Sheet, meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous material, identified in paragraph b of this clause. Data shall be submitted in accordance with Federal Standard No. 313, whether or not the apparently successful offeror is the actual manufacturer of these items. Failure to submit the Material Safety Data Sheet prior to award may result in the apparently successful offeror being considered nonresponsible and ineligible for award.

e. If, after award, there is a change in the composition of the item(s) or a revision to Federal Standard No. 313, which renders incomplete or inaccurate the data submitted under paragraph d of this clause or the certification submitted under paragraph c of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

f. Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

g. Nothing contained in this clause shall relieve the Contractor from complying with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

h. The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

(1) To use, duplicate and disclose any data to which this clause is applicable. The purposes of this right are to -

(i) Apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting or disposing of hazardous materials.

(ii) Obtain medical treatment for those affected by the material; and

(iii) Have other use, duplicate, and disclose the data for the Government for these purposes

(2) To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph (h)(1) of this clause, in precedence over any other clause of this contract providing for rights in data.

(3) The Government is not precluded from using similar or identical data acquired from other sources. (FAR 52.223-3)

#### 34 SAFETY AND HEALTH REQUIREMENTS MANUAL

If this contract is for construction or dismantling, demolition, or removal of improvements with any Department of Army agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation. The latest edition of the U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, as referenced in the Accident Prevention clause of Section 00700 CONTRACT CLAUSES, is dated 2 SEP 1996.

Before commencing the work, the Contractor shall: (1) Submit a written proposal for implementing the Accident Prevention Plan; and (2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

### 35 SPECIAL SCHEDULING REQUIREMENTS FOR MECHANICAL AND ELECTRICAL SYSTEMS

In reference to the contract clause entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS", see Section 01450 TESTING FOR MECHANICAL AND ELECTRICAL SYSTEMS for additional scheduling requirements for such systems.

### 36 SUBMISSION OF CLAIMS

The following shall be submitted to the Contracting at the following address: U.S. Army Corps of Engineers, New York District, 26 Federal Plaza, New York, New York 10278-0090:

- a. claims referencing or mentioning the Contracting Disputes Act of 1978
- b. requests for a written decision by the Contracting Officer
- c. claims certified in accordance with the Contract Disputes Act of 1978

No other Government representative is authorized to accept such requests. A copy shall also be provided to the Authorized Representative of the Contracting Officer.

The Contractor shall also provide the Contracting Officer with a copy of any requests for additional time, money or interpretation of contract requirements which were provided to the Authorized Representative of the Contracting Officer and which have not been resolved after 90 days.

### 37 PARTNERSHIP IMPLEMENTATION PLAN

To more effectively accomplish this contract, the Government proposes to form a partnership with the Contractor. This partnership would draw on the strengths of each organization in an effort to achieve a quality product within budget and on schedule. This partnership would be bilateral in make-up and participation would be totally voluntary. The Contractor shall hire a facilitator who would be responsible to arrange for an offsite conference location, provide all workshop materials, and compile and distribute a completed partnering agreement to all participants within 30 days of the partnering session. Conference site location will be coordinated with the Contracting Officer for approval. Contractor should plan for the attendance of approximately 15-20 individuals from the Government in addition to the Contractor's and Sub-contractor's personnel. The

costs associated with the partnership conference will be borne by the Contractor. It is anticipated that the partnership conference will be for one day each time and will be held on a monthly basis.

### 38. PRECONSTRUCTION CONFERENCE

a. A preconstruction conference will be arranged by the Contracting Officer, or his Representative, after award of contract and before commencement of work. The Contracting Officer's representative will notify the Contractor of the time and date set for the meeting. At this conference, the Contractor shall be oriented with respect to Government procedures and line of authority, contractual, administrative, and construction matters. Additionally, a schedule of required submittals will be discussed.

b. The Contractor shall bring to this conference the following items in either completed or draft form:

- The Contractor's order of work
- Accident Prevention Plan
- Quality Control Plan
- Letter appointing Superintendent
- List of subcontractors.

### 39. GOVERNMENT RESIDENT MANAGEMENT SYSTEM AND CONTRACTOR QUALITY CONTROL MODULE

The Government will utilize an in-house Contract Administration program entitled "Resident Management System" (RMS). The Contractor shall utilize a Government furnished CQC Programming Module. The following hardware and software are needed by the contractor to run RMS: A personal computer with 8-0386 processor (or higher) and four megabytes (MB) or more of random access memory (RAM) and a 3-1/2 inch high density floppy drive. Also needed is a HP Laser Jet Series II or III printer, a color monitor, MS-DOS version 5.0 or later, and computer files = 81. The Module includes a Daily CQC Reporting System form, which must also be used. This form may be in addition to other contractor desired reporting forms. However, all other such reporting forms shall be consolidated into this one Government specified Daily CQC Report Form. The contractor will also be required to complete CQC Module elements which include, but are not limited to, all Contractor Quality Control plan information such as; Prime Contractor staffing, subcontractor information showing trade, name, address, and point of contact, definable features of work, pay activities and activity information, required Quality Control tests tied to individual pay activities, planned User schooling tied to specific specification paragraphs and pay activities, Installed Property listings, Transfer Property listings, and submittal information relating to specification section, description, pay activity, and expected procurement period. The sum of all pay activities shall equal the contract amount, and all Bid Items, Options and Additives shall be separately identified, in accordance with the Bidding Schedule. Bid Items may include multiple

activities, but activities may only be assigned to one such Bid Item. This module shall be completed to the satisfaction of the Contracting Officer prior to any contract payment (except for Bonds, and Insurance, as approved by the Contracting Officer) and shall be updated as required.

During the course of the contract, the contractor will receive various Quality Assurance comments from the Government that will reflect corrections needed to contractor activities or reflect outstanding or future items needing attention of the contractor. The contractor will acknowledge receipt of these comments by specific number reference on his daily CQC report, and will also reflect on his daily CQC report when these items are specifically completed or corrected to permit Government verification.

#### 40 CONSTRUCTION COLOR BOARD SUBMITTALS

The Contractor shall submit five sets of color boards depicting samples of all finish materials. The color board (finishes sample submittal package) shall include all visible exterior and interior materials and finishes that are a part of the building (and/or structure) or built-in items provided under this contract. The color boards shall be delivered to each of the addresses listed below.

4 Color Boards to: Paul Kara  
Resident Office  
New York District  
Building 5212  
Maryland Avenue  
Fort Dix, NJ 08640

1 Color Board to: Mason and Hangar  
2355 Harrodsbury Road  
Lexington, KY 40504

The Contractor shall furnish his color board submitted to each of the addresses within 90 days after receipt of the notice to proceed, but more than 30 days prior to ordering finishing materials. The Contractor should obtain approvals of his entire color board submission before beginning any work involving final finishes.

The Contractor shall use the following format when assembling the color boards:

a. Provide the samples on 8 ½ x11-inch board modules with a maximum spread of 25 ½ x33-inches for foldouts. Label the modules with the project titles and design them to fit in a standard loose-leaf, three-post binder. The modules should support and anchor all samples. Anchor large or heavy samples with mechanical fasteners.

b. Organize the submittals in a logical manner to allow a fast review. Write descriptions and explanations clearly. Drawings and photographs must be clear and concise.

c. Organize samples by scheme with a separate scheme for each room or for groups of rooms with the same scheme. Coordinate the schemes by room names and numbers shown on the architectural floor plans and room finish and color schedule. Include floor plans and schedules in modules.

d. Indicate true pattern color and texture for interior material and finish samples. Carpet samples should be large enough to indicate a complete pattern or design, but not less than 3 by 5 inches.

e. Include color/finish pattern and texture for exterior materials and finishes

f. Provide at least a 6x6-inch square sample where either interior or exterior special finishes, such as architectural concrete or pre-finished textured metal panels, are required.

#### 41. YEAR 2000 COMPLIANCE

##### a. Commercial Computer Systems and Programming

The Contractor shall warrant fault free performance in the processing of date and related data (including but not limited to calculating, comparing, and sequencing) by all hardware and software products, individually and in combination from date of contract award. Fault free performance shall include the manipulation of this data when dates are in the 20<sup>th</sup> and 21<sup>st</sup> centuries and shall be transparent to the User.

##### b. Microprocessors as Part of Systems

All microprocessor-based equipment, software, or firmware which will be required to process date/time calculations, installed in any system in this contract shall be year 2000 compliant. Typical systems include, but are not limited to, Fire Alarm Systems, Intrusion Detection Systems, HVAC Control Systems, Utility or Energy Monitoring and Control Systems, Traffic Control systems, Elevator Controls, telephone systems, electrical substation controls, utility monitoring and controls at energy plants or fuel storage facilities, local area networks, communications systems, public address systems, and specialty systems such as for research laboratories, etc. These systems shall be year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the 20<sup>th</sup> and 21<sup>st</sup> centuries, including leap year calculations. In addition, these systems, when used in combination with other information technology (either installed as part of this contract or

by others) shall accurately process date/time data, provided the other information technology properly exchanges date/time data with it.

**42, WEIGHTED GUIDELINES METHOD FOR THE CALCULATION OF PROFIT FOR CONTRACT MODIFICATIONS.**

Factor	Rate	Weight	Value
Degree of risk	20		
Relative difficulty of work	15		
Size of job	15		
Period of performance	15		
Contractor's investment	5		
Assistance by government	5		
Subcontracting	<u>25</u>		
	100		_____ %

42.1 For every modification executed under this contract, profit shall be calculated by considering at every tier, each of the above factors. These factors shall be weighted from .03 to .12 as indicated below. The value column, when totaled, indicates the fair and reasonable profit percentage for the modification. This method shall be used, at every contracting tier, to establish the profit factor, for that tier, for every modification under this contract.

42.1.1 Degree of Risk.

Where the work involves no risk or the degree is very small, the weighting should be .03; as the degree of risk increases the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than unit price items for which quantities are provided. Other things to consider: The portion of the work to be done by subcontractors, nature of the work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, whether the negotiation is before or after performance of work, etc.

42.1.2 Relative Difficulty of Work.

If the work is most difficult and complex the weighting should be .12 and should be proportionately reduced to .03 to the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: The nature of the work, by whom it is to be done, where, what is the time schedule, etc.

42.1.3 Size of Job.

All work not in excess of \$100,000 shall be weighted at .12. Work estimated between \$100,000 and \$5,000,000 shall be proportionately weighted from .12 to .05. Work from \$5,000,000 to \$10,000,000 shall be weighted at .04 and work in excess of \$10,000,000 at .03.

42.1.4 Periods of Performance.

Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. the term “jobs” refers to the duration of work required under the modification.

#### 42.1.5 Contractor’s Investment.

To be weighted from .03 to .12 on the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, government-furnished property, method of making progress payments, etc.

#### 42.1.6 Assistance by Government.

To be weighted from .12 to .03 on the basis of average to above average. things to consider: use of government owned property, equipment and facilities, expediting assistance, etc.

#### 42.1.7 Subcontracting.

To be weighted inversely proportional to the amount of subcontracting. Where 80% or more of the work is to be subcontracted the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the contractor’s own forces.

42.2. When considered necessary because of unusual circumstances or local conditions, the range of weight may be increased to an upper limit of .15 if supported by adequate justification and approval of the ACO.

#### 43. PRICING of CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY:

The contractor shall promptly furnish and shall cause any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures, and equipment furnished and/or installed by the contractor or subcontractor, except prices do not need to be provided for Government-furnished Property. This information shall be listed in the RMS CQC Module furnished by the Government.





























































































































































# STATEMENT AND ACKNOWLEDGMENT

FORM APPROVED OMB NO  
9000-0014

Public reporting burden for this collection of information is estimated to average .15 hours per response, including the time for reviewing instructions. Searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the suggestions for reducing this burden, to the FAR Secretarial (VRS), Office of Federal Acquisition and Regulatory Policy, GSA Washington, D.C. 20405: and to the Office of Management and Budget, Paperwork Reduction Project (9000-0014), Washington, D.C. 20503

## PART I - STATEMENT OF PRIME CONTRACTOR

1. PRIME CONTRACT NO.	2. DATE SUBCONTRACT AWARDED	3. SUBCONTRACT NUMBER
4. PRIME CONTRACTOR (Name, address and ZIP code)		5. SUBCONTRACTOR (Name, address and ZIP code)
6. The prime contractor states that under the contract shown in item 1, a subcontract was awarded on date shown in item 2 by (Name of Awarding Firm)		

to the subcontractor identified in item 5, for the following work:

7. PROJECT	8. LOCATION	
9. NAME AND TITLE OF PERSON SIGNING	10. BY (Signature)	11. DATE SIGNED

## PART II - ACKNOWLEDGMENT OF SUBCONTRACTOR

12. The subcontractor acknowledges that the following clauses of the contract shown in item 1 are included in this subcontract:

Contract Work Hours and Safety	David-Bacon Act
Standards Act - Overtime	Apprentices and Trainees
Compensation - Construction	Compliance with Copeland Regulations
Payrolls and Basic Records	Subcontracts
Withholding of Funds	Contract Termination-Debarment
Disputes Concerning Labor Standards	Certification of Eligibility

13. NAME(S) OF ANY INTERMEDIATE SUBCONTRACTORS, IF ANY

14. NAME AND TITLE OF PERSON SIGNING	15. BY (Signature)	16. DATE SIGNED
--------------------------------------	--------------------	-----------------

(Sample of Typical contractor Quality report)

CONTRACTOR'S NAME  
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract No: \_\_\_\_\_ Date: \_\_\_\_\_ Report No. \_\_\_\_\_

Project Name \_\_\_\_\_

Weather: (Clear) (P. Cloudy) (Cloudy); Temperature: \_\_\_\_Min. \_\_\_\_Max; \_\_\_\_ Rainfall \_\_\_\_ in.

<u>Contractor/Subcontractors/Supplier</u>	<u>Area of Responsibility</u>
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____
e. _____	_____
f. _____	_____
g. _____	_____

1. Definable Features of Construction in Progress: (Give briefly only definable features of work in progress and location. Refer to work performed by prime and/or subcontractor and/or supplier by letter in table above).

---

2. Material and/or Equipment Delivered to site:

---

3. Results of Surveillance:

Preparatory Phase (Attach minutes):

Initial Phase (Attach minutes):

Follow-up Phase (Include satisfactory work completed and/or deficiencies with action to be taken):

24 October 1988

4. Tests Required by Plans and/or Specification Performed and results of Test:  
(Attach results of test taken on previous dates).

- 
5. Verbal Instructions Received: (List any instructions given by Government Personnel on construction deficiencies. Retesting required, etc., with action to be taken).

- 
6. Safety Deficiencies Noted. (Describe corrective actions taken).

- 
7. Remarks: (Cover any conflicts in plans, specifications, or instruction).

---

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

---

Contractor's Authorized QC Representative

All Construction Project Identification signs and Safety Performance signs are to be fabricated and installed as described below. The signs are to be erected at a location designated by the contracting officer and shall conform to the size, format, and typographic standards shown

The sign panels are to be fabricated from .75" High Density Overlay Plywood.

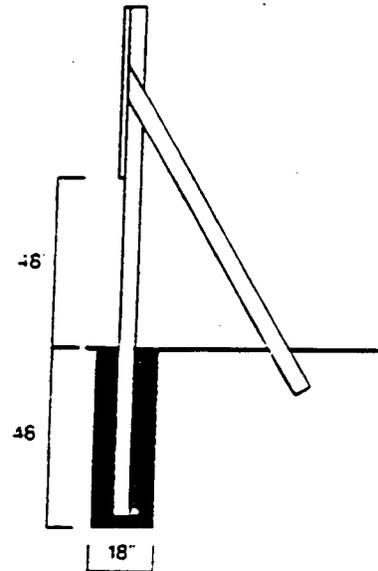
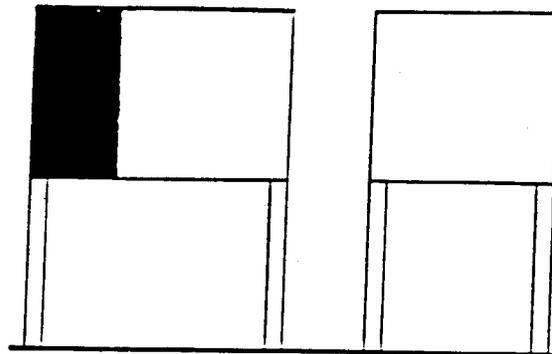
All graphics are to be applied to the background panel following the graphic formats as indicated.

Drill and insert six (6) .375" T-nuts from the front face of the HDO sign panel. Flange of T-nut to be flush with sign face.

Apply lettering and logo to prepared HDO plywood panel.

Sign uprights to be structural grade 4"x4" treated Douglas Fir or Southern Yellow Pine, No. 1 or better. Post to be 12' long. Drill six (6) .375" mounting holes in uprights to align with T-nuts in sign panel. Countersink (.5") back of hole to accept socket head cap screw (4"x.375").

Assemble sign panel and uprights. Imbed assembled sign panel and uprights in 4' hole. Bolt additional 2"x4" struts on inside face of uprights to reinforce installation as shown.



**Construction Project Sign**

**Legend Group 1: Corps Relationship**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

**Legend Group 2: Corps Signature**

- 1. U.S. Army Corps
- 2. of Engineers

**Legend Group 2A: District Name**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

**Legend Group 3: Project Title**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_

**Legend Group 4: Facility Name**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

**Legend Group 5a: Designer**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

**Legend Group 5b: Contractor**

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

## Introduction: Project Identification Sign

Below are two samples of the construction project identification sign showing how this panel is adaptable for use to identify either civil works projects with a local sponsor (top) or military (bottom). The graphic format for this 4' x 6' sign panel follows the legend guidelines and layout as specified

below. The large 4' x 4' section of the panel on the right is to be white with black legend. For the top sign, the upper left 2' x 2' section of the sign with the full Corps signature is to be painted Communications Red with white lettering. The lower left 2' x 2' section of the sign shall match the local sponsor's colors

with white lettering. For the bottom sign, the 2' x 4' left section of the sign with full Corps signature is to be painted Communications Red with white lettering. Mounting and fabrication details are provided.

**Legend Group 1:** One-to two-line description of Corps relationship to project.  
 Color: White  
 Typeface: 1.25" Helvetica Regular  
 Maximum line length: 19"

**Legend Group 2:** Two-line Corps Signature (US Army Corps of Engineers). Placed below Corps Castle  
 Color: White  
 Typeface: 1.5" Helvetica Bold

**Legend Group 2a:** District Name. Placed below Signature (6" Castle).  
 Color: White  
 Typeface: 1.25" Helvetica Regular

**Legend Group 3:** Words "Local Sponsor"  
 Color: White  
 Typeface: 1.25" Helvetica Regular  
 Maximum length: 19"

**Legend Group 4:** One-to-three lines for name of local sponsor  
 Color: White  
 Typeface: 1.5" Helvetica Regular

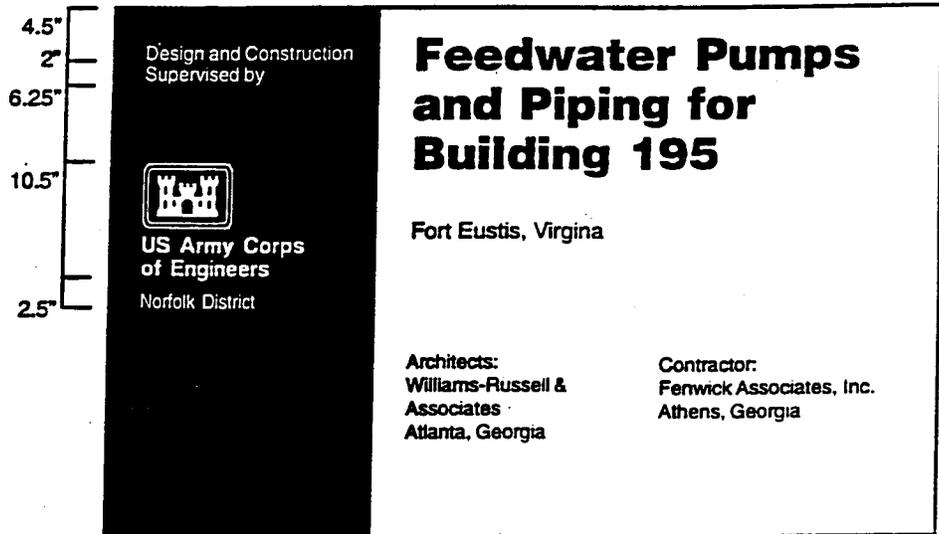
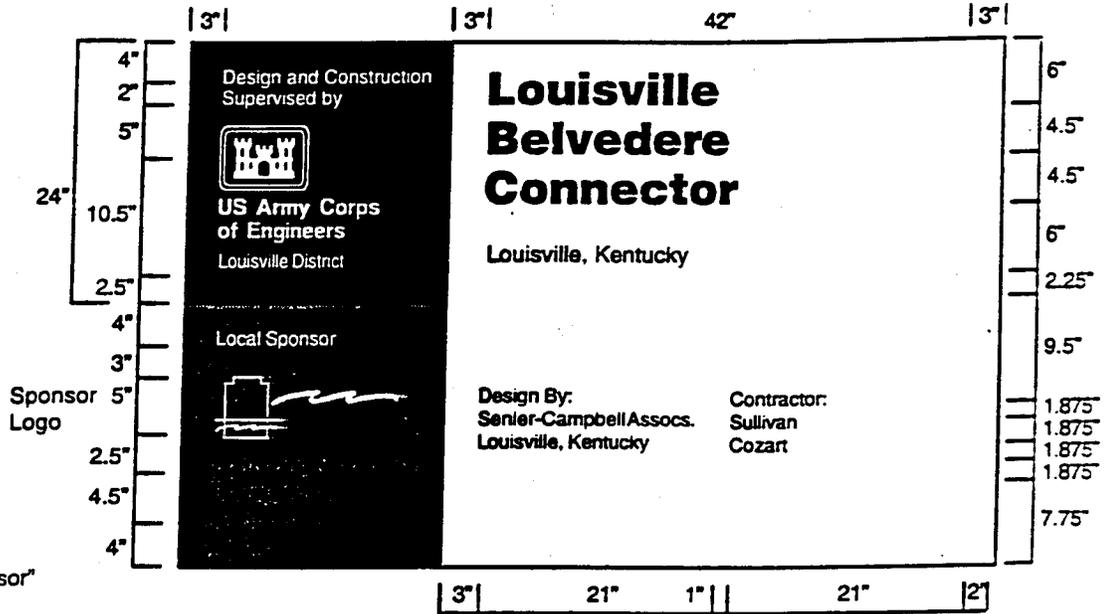
**Legend Group 5:** One- to three-line project title legend describes the work being done under this contract.  
 Color: Black  
 Typeface: 3" Helvetica Bold  
 Maximum line length: 42"

**Legend Group 6:** One- to two-line identification of project or facility (civil works) or name of sponsoring department (military).  
 Color: Black  
 Typeface: 1.5" Helvetica Regular  
 Maximum line length: 42"

Cross-align the first line of Legend Group 5 with the first line of the Corps Signature (US Army Corps) as shown.

**Legend Groups 7a-b:** One- to five-line identification of prime contractors including: type (general contractor, etc.) corporate or firm name, city, state.  
 Color: Black  
 Typeface: 1.25" Helvetica Regular  
 Maximum line length: 21"

All typography is flush left and rag right, upper and lower case with initial capitals only as shown.



Legend Size	Panel Size	Post Size	Mounting Height	Color Bkg/Lgd
Various	4' x 6'	4" x 4"	48"	WH-RD/BK



## Instructions

1. Section I will be initiated by the contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; in resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.
5. Separate transmittal form will be used for submittals under separate section of the specifications.
6. a check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications—also, a written statement to that effect shall be included in the space provided for "Remarks.
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g. to each item submitted.

### THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

- A – Approved as submitted.
  - B – Approved, except as noted on drawings.
  - C – Approved, except as noted on drawings. Refer to attached sheet resubmission required.
  - D – Will be returned by separate correspondence.
  - E – Disapproved (See attached).
  - F – Receipt acknowledged.
  - FX – Receipt acknowledged, does not comply as noted with contract requirements.
  - G – Other (*Specify*)
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

*(Reverse of ENG form 4025-R)*



General Decision Number NJ990002

Superseded General Decision No. NJ980002

State: New Jersey Construction Type:

BUILDING

HEAVY

HIGHWAY

County(ies):

ATLANTIC	CUMBERLAND	OCEAN
BURLINGTON	GLOUCESTER	SALEM
CAMDEN	MERCER	
CAPE MAY	MONMOUTH	

Building (excluding single family homes and apartments up to and including 4 stories), Heavy and Highway Construction Projects.

Modification Number Publication Date

0	01/22/1999
1	03/19/1999
2	04/02/1999
3	05/07/1999
4	05/14/1999
5	05/21/1999
6	06/04/1999
7	07/02/1999
8	07/09/1999

COUNTY(ies):

ATLANTIC	CUMBERLAND	OCEAN
BURLINGTON	GLOUCESTER	SALEM
CAMDEN	MERCER	
CAPE MAY	MONMOUTH	

ASBE0014C 05/01/1998

Rates Fringes

BURLINGTON (townships of Edgewater Park, Lumberton, Sampton, Shamong, Tabernacle, Westhampton, & Willingboro), CAMDEN, & GLOUCESTER COUNTIES:

ASBESTOS WORKERS/INSULATORS

(includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems. Also the application of firestopping material, openings and penetrations in walls, floors, ceilings, curtain walls and all lead abatement).

25.835 12.925

-----  
 ASBE0085A 06/01/1994

Rates Fringes

ASBESTOS WORKERS/INSULATORS

Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems

ZONE 1	20.20	6.35
ZONE 2	18.30	6.825

ZONE 3 19.64 4.04

ASBESTOS WORKERS ZONE DEFINITIONS

ZONE 1: ATLANTIC, BURLINGTON (Bass River and Washington Twps.); CAPE MAY, CUMBERLAND AND OCEAN (Eaglewood, Lacy, Little Egg Harbor, Long Beach, Ocean, Stafford, Tuckerton, and Union Twps.) COUNTIES.

ZONE 2: MONMOUTH (Remainder of County)

ZONE 3: SALEM COUNTY

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ASBE0089G 07/01/1998

Rates Fringes  
BURLINGTON (includes the townships of Bordentown, Burlington, Chesterfield, Easthampton, Florence, Mansfield, Mount Holly, New Hanover, North Hanover, Pembereton, Roebling, Springfield, Wrightstown, & Woodland); MERCER COUNTY; MONMOUTH (includes the townships of Allentown, Blansingburg, Brielle, Englishtown, Farmingdale, Freehold, Howell, Manasquan, Millstone, Roosevelt, Sea Crit, South Belmar, Spring Lake Heights, Upper Freehold, Wall, & West Belmar); & OCEAN (includes the townships of Beachwood, Berkeley, Breton Woods, Brick, Cederwood Park, Dover, Gillford Park, Island Beach, Island Heights, Jackson, Lakehurst, Lakewood, Manchester, New Egypt, Ocean Gate, Pine Beach, Plumstead, South Toms River & Toms River) COUNTIES:

ASBESTOS WORKERS/INSULATORS

Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems

25.545 14.195

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BOIL0028C 08/01/1998

Rates Fringes  
BOILERMAKERS 30.23 40%+4.08

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BRNJ0006A 11/01/1996

Rates Fringes  
BURLINGTON AND MERCER COUNTIES:  
BRICKLAYERS, STONEMASONS, MARBLE MASONS, CEMENT MASONS, (Excludes Building Construction for Mercer County), PLASTERERS, TILE LAYERS, & TERRAZZO WORKERS 24.34 12.10

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BRNJ0007A 11/01/1996

Rates Fringes  
CAMDEN, GLOUCESTER AND SALEM COUNTIES  
BRICKLAYERS, MARBLE MASONS, STONE MASONS AND TERRAZZO WORKERS 25.26 11.15

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BRNJ0008A 11/01/1996

Rates Fringes  
MONMOUTH AND OCEAN COUNTIES  
BRICKLAYERS, CEMENT MASONS, MARBLE MARBLE MASONS, PLASTERERS STONE MASONS, TERRAZZO WORKERS, AND TILE LAYERS 24.88 11.56

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BRNJ0033A 11/01/1996

	Rates	Fringes
ATLANTIC, CAPE MAY AND CUMBERLAND COUNTIES BRICKLAYERS, CEMENT MASONS, MARBLE MASONS, PLASTERERS, STONEMASONS, TERRAZZO WORKERS & TILE LAYERS	23.75	12.76
-----		
CARP0031B 05/01/1997		
	Rates	Fringes
MERCER COUNTY (Remainder)		
CARPENTERS & INSULATORS	26.28	12.34
MILLWRIGHTS	26.28	12.34
-----		
CARP0454B 07/01/1998		
	Rates	Fringes
DOCK BUILDERS & PILEDRIVERMEN	24.08	15.36+A
FOOTNOTE:		
A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Presidential Election Day, and Thanksgiving Day; provided employee works any of the 3 days in the 5-day work week preceeding the holiday and the first work day after the holiday.		
-----		
CARP0623A 05/01/1998		
	Rates	Fringes
ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER AND SALEM COUNTIES		
CARPENTERS, INSULATORS, MILLWRIGHTS AND SOFT FLOOR LAYERS	27.14	42%+.15
-----		
CARP0781A 05/01/1997		
	Rates	Fringes
MERCER COUNTY (Beginning from the present Post Office in Lawrenceville to a point Northward through the present "Radio Site" to the junction of Rosedale Road and Read's Mill Road to the junction of Pennington and Mount Rose Road to the Somerset County line, again starting at the present Post Office in Lawrenceville and Eastward to the junction of Brunswick Pike and Delaware and Raritan Canal Bridge taking the center of the Road to CLarksville then South on Providence Line Road to the Pennsylvania Railroad then East on Dutch Neck North to Grover's Mills to the Middlesex County Line)		
CARPENTERS	27.20	.155+38%
MILLWRIGHTS	27.70	.155+38%
-----		
CARP0999B 12/03/1994		
	Rates	Fringes
CAMDEN, GLOUCESTER AND SALEM COUNTIES		
TERRAZZO FINISHERS	12.93	5.05
-----		
CARP0999C 12/03/1994		
	Rates	Fringes
ATLANTIC AND MONMOUTH COUNTIES:		
TILE FINISHERS	8.45	13%
-----		
CARP0999D 12/03/1994		
	Rates	Fringes

CAMDEN, GLOUCESTER AND SALEM COUNTIES		
TILE FINISHERS	12.72	5.05
-----		
CARP0999E 12/03/1994		
	Rates	Fringes
CAMDEN, GLOUCESTER AND SALEM COUNTIES		
MARBLE FINISHERS	12.95	5.05
-----		
CARP1456G 07/01/1995		
	Rates	Fringes
DIVERS	34.05	17.20
DIVER TENDERS	25.56	17.20
-----		
CARP1456H 07/01/1995		
	Rates	Fringes
MERCER AND MONMOUTH COUNTIES		
DOCK BUILDERS & PILEDRIVERMEN	27.98	17.20
-----		
CARP2018A 05/01/1999		
	Rates	Fringes
OCEAN COUNTY		
CARPENTERS	27.85	42%
MILLWRIGHTS	28.35	42%
-----		
CARP2212B 05/01/1999		
	Rates	Fringes
BURLINGTON, MERCER, MONMOUTH AND OCEAN COUNTIES		
SOFT FLOOR LAYERS	25.75	39.73%
-----		
CARP2250A 05/01/1998		
	Rates	Fringes
MONMOUTH COUNTY		
CARPENTERS	27.14	42%+.15
MILLWRIGHTS	27.64	42%+.15
-----		
ELEC0269D 10/01/1998		
	Rates	Fringes
BURLINGTON (Area North of a line following the West and South limits of Burlington Borough from the Delaware River in a Southeasterly direction to the Burlington - Mt Holly Road, South-Southeast along this Road to and including the Town of Mount Holly, East along the Pennsylvania Railroad to and including New Lisbon and continuing along the Pennsylvania Railroad to Ocean County Line), AND MERCER COUNTIES		
LINE CONSTRUCTION (EXCEPT RAILROAD WORK):		
Linemen, Cable Splicers, Truck Drivers, Equipment Operators and Technicians	30.34	5.75+29%
Groundmen and Winch Operators	24.27	5.75+29%
-----		
ELEC0269E 04/01/1999		
	Rates	Fringes
BURLINGTON COUNTY (Area North of a line following the West and South limits of Burlington Borough from the Delaware River in a Southeasterly direction to the Burlington - Mount Holly Road, South-Southeast along this road to and including the Town of Mount Holly, East along the Pennsylvania Railroad to and		

including New Lisbon and continuiong along the Pennsylvania Railroad to the Ocean County Line) AND MERCER COUNTIES

ELECTRICIANS & CABLE SPLICERS	31.13	5.20+28%
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 ELEC0351A 04/05/1999

	Rates	Fringes
ATLANTIC; BURLINGTON (Edgewater park, Delanco, Delran, Cinnaminson,Moorestown, Mount Laurel, Wilingsboro, Hainesport, Lumberton,Medford, Evesham Townships; and the portion of Shamong, Tabernacle, and Woodland Townships North of the Central Railroad of New Jersey Line; and the portion of Burlington, Westhampton, Easthampton, South Hampton and Pemberton Townships South of a line starting at the Delaware River and following the Southern boundary of Burlington Borough to the Burlington - Mount Holly Road, along this road to Mount Holly around but excluding Mount Holly to the Pennsylvania Railroad along the Pennsylvania Line through, but excluding, Pemberton, through but excluding New Lisbon to the Ocean County line and that portion south of the Central Railroad of New Jersey line running through Chatsworth); CAMDEN; CAPE MAY; CUMBERLAND; GLOUCESTER; and SALEM COUNTIES:		
ELECTRICIANS & CABLE SPLICERS	28.96	45.05%+,45

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 ELEC0351C 04/05/1999

	Rates	Fringes
ATLANTIC; BURLINGTON (Edgewater park, Delanco, Delran, Cinnaminson,Moorestown, Mount Laurel, Wilingsboro, Hainesport, Lumberton,Medford, Evesham Townships; and the portion of Shamong, Tabernacle, and Woodland Townships North of the Central Railroad of New Jersey Line; and the portion of Burlington, Westhampton, Easthampton, South Hampton and Pemberton Townships South of a line starting at the Delaware River and following the Southern boundary of Burlington Borough to the Burlington - Mount Holly Road, along this road to Mount Holly around but excluding Mount Holly to the Pennsylvania Railroad along the Pennsylvania Line through, but excluding, Pemberton, through but excluding New Lisbon to the Ocean County line and that portion south of the Central Railroad of New Jersey line running through Chatsworth); CAMDEN; CAPE MAY; CUMBERLAND; GLOUCESTER; and SALEM COUNTIES:		
LINEMAN,HEAVY EQUIPMENT OPERATOR,&		
CABLE SPLICERS	28.96	46.05%+.25
GROUNDMAN	24.62	46.05%+.25

-----  
 ELEC0400A 06/01/1997

	Rates	Fringes
MONMOUTH AND OCEAN COUNTIES		
ELECTRICIANS & CABLE SPLICERS	28.96	5.90 + 18%

-----  
 ELEC0400B 06/02/1997

	Rates	Fringes
MONMOUTH AND OCEAN COUNTIES		
LINE CONSTRUCTION (Excluding Railroad construction):		
Lineman, Equipment Operator,		
and Cable Splicer	28.96	18.75%+5.83
Groundman	27.01	18.75%+5.83

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 ELEC0999A 12/03/1994

	Rates	Fringes
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BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, MONMOUTH,  
OCEAN AND SALEM COUNTIES:

LINE CONSTRUCTION (RAILROAD ONLY):

Linemen	16.96	25%
Line Equipment Operator	16.20	25%
Groundman Winch Operator	13.07	25%
Groundman	11.06	25%
Dynamite Man	14.20	25%
Street Light Mechanic	12.97	25%
Line Equipment Mechanic	12.90	25%

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ELEV0999A 12/03/1994

	Rates	Fringes
ELEVATOR MECHANICS	24.01	5.22+A

FOOTNOTE:

- A. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day  
PAID VACATION: Employer contributes 4% of basic hourly rate as vacation pay credit for 5 years or more of service, and 2% for 6 months to 5 years of service.

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ENGI0825B 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS: BUILDING CONSTRUCTION PROJECTS; HEAVY; HIGHWAY; ROAD; STREET AND SEWER PROJECTS:		
GROUP 1	30.62	14.90+A+B
GROUP 2	29.03	14.90+A+B
GROUP 3	27.12	14.90+A+B
GROUP 4	25.49	14.90+A+B
GROUP 5	23.78	14.90+A+B
GROUP 6	32.34	14.90+A+B

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Autograde - Combination Subgrader; base metal spreader and 7 base trimmer (CMI and similar types); autograde placer, trimmer, spreader combination (CMI and similar types); autograde slipform paver (CMI and similar types); backhoe; central power plants (all types); concrete paving machines; cranes (all types, including overhead and straddle traveling type); cranes; gantry; derricks (land or floating); drillmaster, quarrymaster (down the hole drill) rotary drill; self propelled hydraulic drill; self-powered drill; dragline; elevator graders; front end loaders (5 yds. and over); gradalls; grader; raygo; locomotive (large); mucking machines; pavement and concrete breaker, i.e.; superhammer and hoe ram; pile driver; length of boom including length of leads, shall determine premium rate applicable; roadway surface grinder; scooper (loader and shovel); shovels; tree chopper with boom; trench machines.

GROUP 2: "A" frame; backhoe (combination); boom attachment on loaders (rate based on size of bucket) not applicable to pipehook, boring and drilling machines; brush chopper; shredder and tree shredder; tree shearer; cableways; carryalls; concrete pump; concrete pumping system; pumpcrete and similar types; conveyors, 125 ft. and over; drill doctor including dust collector, maintenance); front end loaders (2 yds. but less than 5 yds.); graders (finisher); groove cutting machine (ride on type); header planer; hoists; (all types hoists, shall also

include steam, gas, diesel, electric, air hydraulic, single and double drum, concrete brick shaft caisson, snorkel roof, and/or any other similar type hoisting machines, portable or stationary, except Chicago boom type); hoists (Chicago boom type); hydraulic cranes, 10 tons and under, hydro-axle; jacks screw air hydraulic power operated unit or console type (not hand jack or pile load test type); log skidder; pans; pavers (all concrete; pumpcrete machines; squeezecrete and concrete pumping (regardless of size); scrapers; side booms; straddle carrier; ross and similar types; winch truck (hoisting).

GROUP 3: Asphalt curbing machine; asphalt plant engineer; asphalt spreader; autograder tube finisher and texturing machine (CMI and similar types); autograde curercrete machine (CMI and similar types); autograde curb trimmer and sidewalk; shoulder; slipform (CMI and similar types); bar bending machines (power); batchers; batching plant and crusher on side; belt conveyor systems; boom type skimmer machines, bridge deck finisher; bulldozers (all); car dumpers (railroad); compressor and blower type units (used independently or mounted on dual purposes trucks, on job site or in conjunction with job site in loading and unloading of concrete, cement, fly ash, instancrete, or similar type materials); compressor (2 or 3) (battery); concrete finishing machines; concrete saws and cutters (ride on type); concrete spreaders; hetzel; rexomatic and similar types; concrete vibrators, conveyors; under 125 ft.; crushing machines; ditching machine; small (ditchwitch or similar type); dope pots (mechanical with or without pump); dumpsters elevator; fireman; fork lifts (economobile; lull and similar types of equipment); front end loaders (1 yd. and over but less than 2 yds.). generators (2 OR 3) in battery; giraffe grinders; graders and motor patrols; gunnite machines (excluding nozzle); hammer vibratory (in conjunction with generator); hoist (roof, tigger, aerial platform hoist and house cars); hoppers; hopper doors (power operated); ladders (motorized); laddervator; locomotive; dinky type; maintenance; utility man; mechanics; mixers (except paving mixers); motor patrols and graders; pavement breakers, small; self-propelled ride on type (also maintaining compressor or hydraulic unit); pavement breaker; truck mounted; pipe bending machine (power); roller; black top; scales; power; seaman pulverizing mixer; shoulder widener; silos; skimmer machines (boom type); steel cutting machine; services and maintaining tractors; tug captain; vibrating plants (used in conjunction with unloading); welder and repair mechanics, concrete cleaning/decontamination machine operator, directional boring machine, heavy equipment robotics operator/technician, master environmental maintenance technician, ultra high pressure waterjet cutting tool system operator/maintenance technician, vacuum blasting machine operator/maintenance technician.

GROUP 4: Brooms and sweepers, chippers, compressor (single), concrete spreaders (small type), conveyor loaders (not including elevator graders), engines, large diesel (1620 H.P.) and staging pump, farm tractors; fertilizing equipment (operation and maintenance) fine grade machine (small type); form line graders (small type); front loader (under 1 yd.); generator (single); grease, gas, fuel and oil supply trucks; heaters (nelson or other type including propane, natural gas or flow-type units); lights; portable generating light plants; mixers; concrete small;

mulching equipment (operation and maintenance) pumps (4 inch suction and over including submersible pumps); pumps (2 or less than 4" suction and over including submersible pumps); pumps (diesel engine and hydraulic) immaterial of power road finishing machines (small type); rollers; grade; fill or stone base; seeding equipment (operation and maintenance of); sprinkler and water pump trucks steam jennies and boilers, stone spreader; tamping machines; vibrating ride-on; temporary heating plant (nelson or other type, including propane, natural gas or flow type untis); water and sprinkler trucks; welding machines (gas, diesel, and/or electric converters of Any type, single; two or three in a battery); welding systems, multiple (rectifier transformer type); wellpoint systems.

GROUP 5: Oiler.

GORUP 6: Helicopter Pilot.

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day; Washington'd Birthday, Memorial Day; Independence Day; Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day
- B. Employee receives 20% Premium Pay for Hazardous Waste Work.

ENGI0825C 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS		
TANK ERECTION:		
GROUP 1	33.11	14.90+A+B
GROUP 2	32.27	14.90+A+B
GROUP 3	34.25	14.90+A+B
GROUP 4	30.18	14.90+A+B
GROUP 5	24.97	14.90+A+B

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day; Washington's Birthday Memorial Day; Independence Day; Labor Day; Veteran's Day, Thanksgiving Day; and Christmas Day.
- B. Employee receives 20% premium pay for hazardous waste work.

TANK ERECTION CLASSIFICATIONS

GROUP 1: Operating Engineers--on all Cranes, derricks, etc. with booms including jib 140 ft. or more above the ground.  
 GROUP 2: Operating Engineers--on all equipment, including cranes derricks, etc. with booms including jib, less than 140 ft. above the ground.  
 GROUP 3: Helicopters--Pilot.  
 GROUP 4: Air compressors, welding machines and generators (gas, diesel, or electrical driven equipment and sources of power from a permanent plant, i.e., steam, compressed air, hydraulic or other power, for the operating of any machine or automatic tools used in the erection, alteration, repair and dismantling of tanks and any and all "DUAL PURPOSE" trucks used on the construction job site.  
 GROUP 5: Oiler.

ENGI0825D 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
[STEEL ERECTION]:		
GROUP 1	33.39	14.90+A+B
GROUP 2	32.48	14.90+A+B

GROUP 3	30.19	14.90+A+B
GROUP 4	27.53	14.90+A+B
GROUP 5	26.00	14.90+A+B
GROUP 6	24.24	14.90+A+B
GROUP 7	34.75	14.90+A+B

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day.
- B. Employees receive 20% premium pay for hazardous waste work.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

[STEEL ERECTION]

- GROUP 1: Cranes - (all cranes, land or floating with booms including job 140 ft. and over, above ground); derricks-(all derricks, land or floating with boom including jib 140 ft. and over, above ground).
- GROUP 2: Cranes - (all cranes, land or floating with booms including jib less than 140 ft. above ground); derricks (all derricks, land or floating with booms including jib, less than 140 ft. above ground).
- GROUP 3: "A" frame; cherry pickers 10 tons and under; hoists; all types hoists shall also include steam, gas, diesel, electric, air hydraulic, single and double drum, concrete, brick shaft caisson, or any other similar type hoisting machines, portable or stationary, except Chicago boom type; jacks-screw air hydraulic power operated unit console type (not hand jack or pile load test type) side booms.
- GROUP 4: Aerial platform used hoist; compressor, 2 or 3 in battery; elevators or house cars; conveyors and tugger hoists; fireman; forklift; generators, 2 or 3 maintenance-utility man; rod bending machine (power); welding machines--(gas or electric, 2 or 3 in battery, including diesels); captain power boats; tug master power boats.
- GROUP 5: Compressor, single, welding machine, single, gas, electric converters of any type, diesel; welding system multiple (rectifier transformer type); generator, single.
- GROUP 6: Oiler staddle carrier.
- GROUP 7: Helicopter pilot.

-----  
 ENGI0825E 07/01/1999

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
OILOSTATIC MAINLINES & TRANSPORTATION PIPELINES:		
GROUP 1	31.25	14.90+A+B
GROUP 2	29.60	14.90+A+B
GROUP 3	27.46	14.90+A+B
GROUP 4	25.96	14.90+A+B
GROUP 5	24.24	14.90+A+B
GROUP 6	33.18	14.90+A+B

FOOTNOTES:

- A. PAID HOLIDAYS: New Year's Day; Washington's Birthday, Memorial Day; Independence Day; Labor Day; Veteran's Day, Thanksgiving Day; and Christmas Day
- B. Employee receives 20% premium pay for hazardous waste work.

OILOSTATIC MAINLINES AND TRANSPORTATION PIPE LINES

CLASSIFICATIONS

- GROUP 1: Backhoe; cranes (all types); draglines; front-end

loaders (5 yds. and over); gradalls; scooper (loader and shovel); koehring and trench machines.

GROUP 2: "A" frame; backhoe (combination hoe loader); boring and drilling machines; ditching machine, small; ditchwitch or similar type; fork lifts; front end loaders (2 yds and over but less than 5 yds.); graders, finish (fine); hydraulic cranes, 10 tons and under (over 10 tons - crane rate applies); side booms; and winch trucks (hoisting).

GROUP 3: Backfiller; brooms and sweepers; bulldozers; compressors (2 or 3 in battery); front-end loaders (under 2 yds.); generators; giraffe grinders; graders and motor patrols; mechanic; pipe bending machine (power); tractors; water and sprinkler trucks, welder and repair mechanic.

GROUP 4: Compressor (single); dope pots (mechanical with or without pump); dust collectors; farm tractors; pumps (4 in. suction and over); pumps (2 or less than 4 in. suction); pumps; diesel engine and hydraulic (immaterial or power); welding machines; gas or electric converters of any type, single; welding machines, gas or electric converters of any type, 2 or 3 in battery multiple welders; wellpoint systems (including installation and maintenance).

GROUP 5: Oiler, grease, gas, fuel and supply trucks and tire repair and maintenance.

GROUP 6: Helicopter-pilot.

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IRON0011B	07/01/1998		
		Rates	Fringes
MONMOUTH AND OCEAN COUNTIES			
IRONWORKERS:			
Structural & Ornamental		26.13	20.25
Reinforcing		24.63	20.25

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* IRON0068A	07/01/1999		
		Rates	Fringes
BURLINGTON (Remainder), MERCER, MONMOUTH (South half), AND OCEAN (Middle third) COUNTIES			
IRONWORKERS:			
Structual, Ornamental		26.56	18.85
Reinforcing (Concrete Rods)		24.56	18.85

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* IRON0350A	07/01/1999		
		Rates	Fringes
ATLANTIC, CAPE MAY, CUMBERLAND (Area East of a line drawn from Delaware Bay through the town of Cedarsville and upwards to the point where the county lines of Gloucester, Cumberland, and Atlantic meet), AND OCEAN (Remainder) COUNTIES			
IRONWORKERS:			
BUILDING CONSTRUCTION:			
Structural		26.45	16.85
Reinforcing		25.45	16.85
Fencing		23.80	16.85
HIGHWAY CONSTRUCTION:			
Reinforced Concrete		22.95	16.85
Structural		25.50	16.85

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IRON0399A	07/01/1998		
		Rates	Fringes

BURLINGTON (Southern portion up to but not including Lumberton and Chatsworth Twps.), CAMDEN, CUMBERLAND (Remainder), GLOUCESTER, AND SALEM COUNTIES

IRONWORKERS:

Structural, Ornamental, and Reinforcing	26.90	13.15
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LABO0050A 05/01/1999

	Rates	Fringes
MERCER COUNTY (Townships of Princeton, Lawrence, West Windsor, and Borough of Princeton)		

LABORERS (BUILDING CONSTRUCTION):

CLASS A	20.25	11.42
CLASS B	19.75	11.42
CLASS C	16.79	11.42

LABORERS CLASSIFICATIONS (BUILDING CONSTRUCTION)

CLASS A: Jack Hammer; Tamper; Motorized Tampers and Compactors Street Cleaning Machines; Scaffold Builder; Hydro Demolition Equipment; All types of Motorized Fork Lifts; Riding Motor Buggy Operator; Bob Cat Operator; Mortar Man; Burners; Nozzle Man on gunite Work.

CLASS B: All Laborers not listed in Class A or C.

Class C Laborers doing Janitorial type light clean up associated with the turnover of the project or part of a project to the owner; All Flagman; and those manning temporary heat of all types.

:

LABO0172A 03/01/1999

	Rates	Fringes
ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, MERCER, OCEAN AND SALEM COUNTIES		

LABORERS:

GROUP 1	22.25	9.70+A
GROUP 2	22.45	9.70+A
GROUP 3	22.75	9.70+A
GROUP 4	22.95	9.70+A
GROUP 5	23.20	9.70+A
GROUP 6	26.75	9.70+A
GROUP 7	25.25	9.70+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day; Labor Day, Veteran's Day, Presidential Election Day, Thanksgiving Day, and Christmas Day, provided the employee works 3 days for the same Employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

LABORERS CLASSIFICATIONS

GROUP 1: Common laborers, landscape laborers, railroad track laborers, flagmen, salamander tenders, pitman, dumpman, waterproofing laborers, rakers and tampers on cold patch work, and wrapping and coating of all pipes.

GROUP 2: Powder carrier, magazine tender, and signalman.

GROUP 3: Sewer pipe, laser men, conduit and duct line layer, power tool operator, jack hammer, chipping hammer, pavement breaker, power buggy, concrete cutter, asphalt cutter, sheet

hammer and tree cutter operators, sandblasting cutting, burning and such other power tools used to perform work usually done manually by laborers.

GROUP 4: Wagon drill operator, timberman and drill master.

GROUP 5: Finisher, manhole, catch basin or inlet builder, form setter, rammer, paver, gunite nozzleman and stonecutter.

GROUP 6: Blaster.

GROUP 7: Hazardous waste laborer(Excludes asbestos work).

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LABO0172B 03/01/1999

	Rates	Fringes
LABORERS; FREE AIR TUNNEL:		
GROUP 1	26.70	9.70+A
GROUP 2	23.30	9.70+A
GROUP 3	23.15	9.70+A
GROUP 4	22.60	9.70+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day; Independence Day, Labor Day, Presidential Election Day, provided the employee works 3 days for the same Employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

LABORERS; FREE AIR TUNNEL CLASSIFICATIONS

GROUP 1: Blasterers.

GROUP 2: Skilled men (including miners, drill runners, iron men, maintenance men, conveyor men, safety miners, riggers, block layers, cement finishers, rod men, caulkers, powder carriers, all other skilled men).

GROUP 3: Semi-skilled men (including chuck tenders, track men, nippers, brakemen, derail men, cable men, hose men, grout men, gravel men, form men, bell or signal men (top or bottom), form workers and movers, concrete workers, shaft men, tunnel laborers all other semi-skilled).

GROUP 4: All others (including powder watchmen, change house attendants, top laborers).

-----  
LABO0172C 03/01/1999

	Rates	Fringes
ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, MERCER, MONMOUTH, OCEAN, SALEM, AND MIDDLESEX (Southern half) COUNTIES		

LABORERS - ASPHALT CONSTRUCTION:

STREET:

Head Rakers	21.55	11.20+A
Rakers & Screed Men	21.40	11.20+A
Tampers, Smothers, Kettlemen, Painters, Shovelers and Roller Boys	21.15	11.20+A

PLANT:

Scale Mixers & Burner Men	21.40	11.20+A
Feeders and Dust Men	21.15	11.20+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day; Independence Day; Labor Day; Veteran's Day, Presidential Election Day, Thanksgiving Day, and

Christmas Day provided The Employee works 3 days for same employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

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LABO0222A 05/01/1999

BURLINGTON (Twps. of Cinnaminson, Delance, Delran, East Hampton, Edgewater Park, Evesham, Hainesport, Lumberton, Medford, Moorestown, Mount Laurel, Pemberton, Shamong, South Hampton, Tabernacle, West Hampton, Willingsboro and Woodland); CAMDEN; CUMBERLAND; GLOUCESTER; AND SALEM COUNTIES

LABORERS (BUILDING CONSTRUCTION):

	Rates	Fringes
CLASS A	18.42	13.25
CLASS B	17.92	13.25
CLASS C	15.23	13.25

LABORERS CLASSIFICATIONS (BUILDING CONSTRUCTION)

CLASS A: Jack Hammer, Tamper, Motorized Tampers and Compactors, Street Cleaning Machines, Scaffold Builder, Hydro, Demolition Equipment, All types of Motorized Fork Lifts Riding Motor Buggy Operator, Bobcat Operator, Mortar Man, Burners, Nozzle Man on Gunitite work.

CLASS B: All laborers not listed in Class A or C.

CLASS C: Laborers doing Janitorial-type light clean up work associated with the turnover of the project to the owner All Flagman, and those manning temporary heat of all types.

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LABO0343A 05/01/1999

MERCER (Twps. of East Windsor, Hightown, and Washington); MONMOUTH; AND OCEAN (Remainder) COUNTIES

LABORERS:

	Rates	Fringes
Class A	18.70	13.00
Class B	18.20	13.00
Class C	15.47	13.00

LABORER CLASSIFICATIONS

Class A: Jack Hammer; Tamper; Motorized Tampers & Compactors; Street Cleaning Machines; Scaffold Builder; Hydro Demolition Equipment; all types of Motorized Fork Lifts; Riding Motor Buggy Operator; Bobcat Operator Mortar Man; Burners; Nozzle Man on Gunitite work.

Class B: All laborers not listed in Class A or C.

Class C: Laborers doing Janitorial-type light clean up work associated with the turnover of the project to the owner, All flagman, and those manning temporary heat of all types.

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LABO0369A 05/01/1999

BURLINGTON (Remainder); and MERCER (Remainder)  
LABORERS

	Rates	Fringes
	19.30	11.87

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LABO0415A 05/01/1999

ATLANTIC; BURLINGTON (Twps. of Bass River and Washington); CAPE MAY; CUMBERLAND (Twps. of Commercial, Dawne, Fairfiled, Lawrence,

Maurce, and Millville); AND OCEAN (That portion up to and including Lacy Twp.) COUNTIES

LABORERS (BUILDING CONSTRUCTION):

CLASS A	19.75	11.95
CLASS B	19.25	11.95
CLASS C	16.36	11.95

LABORERS CLASSIFICATIONS (BUILDING CONSTRUCTION)

CLASS A: Jack Hammer, Tamper, Motorized Tampers and Compactors, Street Cleaning Machines, Scaffold Builder, Hydro Demolition Equipment, all types of Motorized Fork Lifts, Riding Motor Buggy Operator, Bobcat Operator, Mortar Man, Burners, Nozzle Man on Gunite work.

CLASS B: All laborers not listed in Class A or C.

CLASS C: Laborers doing Janitorial- type light clean up work associated with the turnover of the project to the owner All flagman, and those manning temporary heat of all types.

-----  
LABO0472A 09/01/1997

	Rates	Fringes
MONMOUTH COUNTY		
LABORERS (HEAVY AND HIGHWAY CONSTRUCTION):		
GROUP 1	21.20	9.00+A
GROUP 2	21.40	9.00+A
GROUP 3	21.70	9.00+A
GROUP 4	21.90	9.00+A
GROUP 5	22.15	9.00+A
GROUP 6	25.70	9.00+A
GROUP 7a	24.20	9.00+A
Group 7b	22.20	9.00+A

LABORERS CLASSIFICATIONS (HEAVY & HIGHWAY)

GROUP 1: Common laborers, landscape laborers, railroad track laborers, flagmen, salamander tenders, pitman, dumpman, waterproofing laborers, rakers and tampers on cold patch work, and wrapping and coating of all pipes, & Asphalt Laborers.

GROUP 2: Powder carrier, magazine tender, signalman, asphalt raker, and asphalt screedman

GROUP 3: Sewer pipe, laser men, conduit and duct line layer, power tool operator, jack hammer, chipping hammer, pavement breaker, power buggy, concrete cutter, asphalt cutter, sheet hammer and tree cutter operators, sandblasting cutting, burning, power tool operator, and such other power tools used to perform work usually done manually by laborers.

GROUP 4: Wagon drill operator, timberman and drill master.

GROUP 5: Finisher, manhole, catch basin or inlet builder, form setter, rammer, paver, gunite nozzleman, and stone cutter

GROUP 6: Blaster.

Group 7a: Hazardous waste laborer required to wear level A,B, or C personal protection.

GROUP 7b: Certified laborer working a hazardous waste removal project or site at a task requiring hazardous waste related certification, but who is not working in a zone requiring level A,B, or C personal protection.

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day,

Veteran's Day, Presidential Election Day, Thanksgiving Day,  
 and Christmas Day provided the employee works 3 days for  
 the same employer within a period of 10 working days  
 consisting of 5 working days before and 5 working days  
 after the day upon which the holiday falls or is observed

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 LABO1030A 04/01/1998

	Rates	Fringes
LABORERS: (The removal, abatement, enclosure and decontamination of personal protective equipment, chemical protective clothing and machinery relating to asbestos and/or toxic and hazardous waste of materials which shall include but not necessarily be limited to: the erection, moving, servicing and dismantling to all enclosures, scaffolding, barricades, and the operation of all tools and equipment normally used in the removal or abatement of asbesots and toxic and hazardous waste or materials, the labeling, bagging, cartoning, crating, or other packaging of materials for disposal; and the clean up of the work site and all other work incidental to the removal, abatement, encapsulation, enclosure, and decontamination of asbesots or toxic and hazardous waste materials; and in addition, all work tasks involved in the maintenance and operation of energy resource recover plants (co-generation plants).)		
LABORERS	19.70	9.60

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 PAIN0252H 06/01/1998

	Rates	Fringes
ATLANTIC, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER, SALEM, and parts of BURLINGTON and OCEAN (everything south of these cities in Burlington and Ocean Counties-Florence to Bustleton to Columbus to Jobstown to Pemberton to Ongs Hat to Chatsworth to Whiting to Pinewald to Ocean Gate to Seaside Heights) COUNTIES:		
GLAZIERS	\$23.20	9.78

-----  
 PAIN0711A 05/01/1999

	Rates	Fringes
ATLANTIC, CAPE MAY, & OCEAN ( Municipalities of Eaglewood, Little Egg Harbor, Ocean, Stafford, & Union) COUNTIES:		
PAINTING, PAPERHANGING & ALLIED WORK	28.25	2.54+27%
SPRAYING, SANDBLASTING, DIPPING, POWER TOOLS (Over 115 volts) & PAPERHANGING PASTING APPARATUS WORK ON TANKS, BRIDGES, TOWERS, STACKS, & OPEN STRUCTURAL STEEL, WORK FROM CABLES & SWINGING SCAFFOLDS, EXTERIOR WORK ABOVE THREE STORIES	30.75	2.54+27%
REPAINT WORK & PREPARATION THEREFORE (including jobs where no major alterations are taking place but excluding bridges,		

7	stacks, elevated tanks & generating		
8	stations)	21.80	2.54+27%
9	-----		
0			
1	PAIN0711B 05/01/1999		
2		Rates	Fringes
3	MONMOUTH & OCEAN (excluding the municipalities of Eaglewood,		
4	Little Egg Harbor, Ocean, Stafford, & Union) COUNTIES:		
5			
6	PAINTING, PAPERHANGING & ALLIED WORK	28.25	2.54+27%
7			
8	SPRAYING, SANDBLASTING, DIPPING,		
9	POWER TOOLS (Over 115 volts) &		
0	PAPERHANGING PASTING APPARATUS		
1	WORK ON TANKS, BRIDGES, TOWERS,		
2	STACKS, & OPEN STRUCTURAL STEEL,		
3	WORK FROM CABLES & SWINGING SCAFFOLDS,		
4	EXTERIOR WORK ABOVE THREE STORIES		
5		30.75	2.54+27%
6			
7	REPAINT WORK & PREPARATION THEREFORE		
8	(including jobs where no major alterations		
9	are taking place but excluding bridges,		
0	stacks, elevated tanks & generating		
1	stations)	21.80	2.54+27%
2	-----		
3			
4	PAIN0711C 05/01/1999		
5		Rates	Fringes
6	BURLINGTON, CAMDEN, GLOUCESTER, & SALEM COUNTIES:		
7			
8	PAINTING, PAPERHANGING & ALLIED WORK	28.25	2.54+27%
9			
0	SPRAYING, SANDBLASTING, DIPPING,		
1	POWER TOOLS (Over 115 volts) &		
2	PAPERHANGING PASTING APPARATUS		
3	WORK ON TANKS, BRIDGES, TOWERS,		
4	STACKS, & OPEN STRUCTURAL STEEL,		
5	WORK FROM CABLES & SWINGING SCAFFOLDS,		
6	EXTERIOR WORK ABOVE THREE STORIES		
7		30.75	2.54+27%
8			
9	REPAINT WORK & PREPARATION THEREFORE		
0			
1	(including jobs where no major alterations		
2	are taking place but excluding bridges,		
3	stacks, elevated tanks & generating		
4	stations)	21.80	2.54+27%
5	-----		
6			
7	PAIN0711H 05/01/1999		
8		Rates	Fringes
9	MERCER COUNTY		
0			
1	PAINTERS:		
2			
3	New Construction and		

4	Major Alterations	27.40	27%+2.54
5			
6	Repaint Work	21.80	27%+2.54
7			
8	Spraying or application of		
9	Hazardous or Dangerous		
0	Materials on Repaint Work	23.80	27%+2.54
1			
2	Bridges, TV & Radio Towers,		
3	Structural Steel & Tanks above 3		
4	stories in height (30' or over),		
5	Smoke Stacks, Water Towers, Sand-		
6	Blasting, Steam Cleaning, Spraying,		
7	or application of Hazardous		
8	Materials	31.00	27%+2.54
9			
0	Paperhanging	25.60	27%+2.54
1	-----		
2			
3	PAIN0711J 06/01/1998		
4		Rates	Fringes
5	DRYWALL FINISHERS	27.75	10.72
6	-----		
7			
8	PAIN0711K 05/01/1999		
9		Rates	Fringes
0	MERCER & MONMOUTH COUNTIES:		
1			
2	GLAZIERS:	28.25	10.19
3	-----		
4			
5	PAIN1009A 10/01/1996		
6		Rates	Fringes
7	MIDDLESEX, SOMERSET (Basking Ride, Bernardsville, and Watchung),		
8	AND UNION (Carteret, Port Reading, Fords and Woodbridge) COUNTIES		
9			
0	GLAZIERS	26.15	9.65
1	-----		
2			
3	PAIN1976A 08/01/1998		
4		Rates	Fringes
5	ATLANTIC, BURLINGTON, CAPE MAY, CUMBERLAND, MERCER, MONMOUTH		
6	AND OCEAN COUNTIES		
7			
8	DRYWALL TAPERS & FINISHERS	27.75	10.72
9	-----		
0			
1	PLAS0699A 05/01/1998		
2		Rates	Fringes
3	CAMDEN, GLOUCESTER, AND SALEM COUNTIES		
4			
5	CEMENT MASONS	23.75	11.00
6	-----		
7			
8		NJ990002 - 1	
9	PLUM0009I 03/01/1999		
0		Rates	Fringes

1 AIR CONDITIONING & REFRIGERATION

2 MECHANICS 22.08 7.57

3

4 SCOPE OF WORK:

5 Installation of air conditioning and refrigeration equipment  
6 whose combined tonnage does not exceed 15 tons. Installation of  
7 water cooled air conditioning that does not exceed 10 tons  
8 (includes piping of component system and erection of water  
9 tower). Installation of air cooled air conditioning that does  
0 not exceed 15 tons. Installation of air conditioning equipment  
1 of the "Package-Unitary" rooftop type, the combined tonnage of  
2 which does not exceed 35 tons. Packaged Unitary Air Conditioning  
3 and Refrigeration Institute (ARI) as follows: "A unitary air  
4 conditioner consists of one or more cooling coil, and air moving  
5 device, a compressor and condenser combination, and may include a  
6 heating function as well". Any and all related piping to the  
7 above installation will be done under the appropriate trade  
8 jurisdiction.

9 -----

0

1 PLUM0009J 07/01/1998

2 Rates Fringes

3 BURLINGTON (Remainder), MERCER, MONMOUTH, AND OCEAN COUNTIES:

4

5 PLUMBERS & PIPEFITTERS 29.58 13.85

6 -----

7

8 PLUM0322A 05/01/1999

9 Rates Fringes

0 ATLANTIC; BURLINGTON (The portion of County which includes  
1 Atsion, Bass, River Twp., Batsto, Chatsworth, Green Bank, Herman,  
2 Jenkins, New Gretna, Quaker Bridge, Wading River, Washington and  
3 Woodland Twps; the portion of the County starting on the West by  
4 the Delaware River, on the North by a line following the center  
5 of High Street to the Pennsylvania Railroad running from Camden  
6 to Mt. Holly, Birmingham, Seaside Park and shore points on the  
7 Jersey coast and along aforesaid Railroad to the Town of  
8 Whitings; Thence diagonally across Burlington County to the  
9 Junction of Burlington, Camden, and Atlantic Counties); CAMDEN;  
0 CAPE MAY; CUMBERLAND; GLOUCESTER; AND SALEM COUNTIES

1

2 PLUMBERS/PIPEFITTERS 26.46 15.10

3 -----

4

5 ROOF0004A 06/01/1996

6 Rates Fringes

7 MONMOUTH COUNTY (Remainder), AND OCEAN COUNTIES

8

9 ROOFERS 24.22 11.75

0 -----

1

2 ROOF0030D 05/01/1999

3 Rates Fringes

4 ATLANTIC, BURLINGTON, CAMDEN, CAPE MAY, CUMBERLAND, GLOUCESTER,  
5 MERCER AND SALEM COUNTIES; and the following portions of MONMOUTH  
6 AND OCEAN COUNTIES: West of a line starting from the point on  
7 Route 70 where Burlington and Ocean Counties meet, Easterly along

8 Route 70 to Route 571, along Route 571 to Cassville, Easterly on  
 9 Route 528 to Van Hiseville, Northerly on Route 527 to Manalapan,  
 0 Westerly on Route 33 to the Monmouth County Line

1			
2	ROOFERS:		
3	Shingle, slate and tile	19.25	6.17
4	All other work	24.15	12.15+A
5			

6 FOOTNOTE:  
 7 A. PAID HOLIDAY: Election Day.

8 -----

9  
 0 SFNJ0669B 04/01/1999

1		Rates	Fringes
2	ATLANTIC, BURLINGTON, CAPE MAY, CUMBERLAND, MERCER (Remainder),		
3	MONMOUTH, OCEAN, AND SALEM (Remainder) COUNTIES		
4			
5	SPRINKLER FITTERS	30.65	6.40
6			

7 -----

8 SFNJ0692C 05/01/1998

9		Rates	Fringes
0	CAMDEN, GLOUCESTER, MERCER (Town of Trenton), AND SALEM (Penns		
1	Grove, excluding Penns Grove Airport) COUNTIES		
2			
3	SPRINKLER FITTERS	29.97	9.40
4			

5 -----

6 SHEE0019M 05/01/1999

7		Rates	Fringes
8	CAMDEN, GLOUCESTER, & SALEM COUNTIES:		
9			
0	SHEET METAL WORKER	26.97	15.11+H
1			

2 H-Election Day is a paid holiday.

3 -----

4 SHEE0027B 06/01/1997

6		Rates	Fringes
7	ATLANTIC, BURLINGTON, CAPE MAY, CUMBERLAND, MERCER, MONMOUTH AND		
8	OCEAN COUNTIES		
9			
0	SHEET METAL WORKERS	28.20	13.59
1			

2 -----

3  
 4 SUNJ1002A 12/07/1993

5		Rates	Fringes
6	MERCER COUNTY		
7			
8	CEMENT MASONS (BUILDING		
9	CONSTRUCTION ONLY)	19.60	8.83
0			

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2 TEAM0331A 01/01/1998

3		Rates	Fringes
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TRUCK DRIVERS:

GROUP 1	20.75	8.92+A
GROUP 2	20.90	8.92+A
GROUP 3	21.10	8.92+A
GROUP 4	21.25	8.92+A

FOOTNOTE:

A. PAID HOLIDAYS: New Year's Day; Washington's Birthday; Memorial Day; Independence Day; Labor Day; Veteran's Day; Presidential Election Day; Thanksgiving Day; & Christmas Day; provided the employee works 3 days in the week in which the holiday falls.

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: Striaight Truck Driver, Dump Truck Driver, Water Truck Driver, Transit Mix Driver, Pickup Truck Driver, Tank Truck Driver, Track Truck Driver, Agitator Truck Driver, Concrete Mobile Unit Driver, Tringer Bead Truck Driver, Ross Carrier Driver, Warehouse Forklift Driver, A Frame Truck Driver, Gin Pole Truck Driver, Form Truck Driver, Driver for Truck having Self Loading/Unloading Attachment, & Vacuum Truck/Trailer.

GROUP 2: Trucks Towing Driver

GROUP 3: Trailer Truck Driver, Winch Truck Driver, Off Road Dump Truck Driver, Fuel Truck Driver, Tractor Trailer (any trailer driver), Asphalt Oil Distributor Driver, & Off Road Water Truck Driver.

GROUP 4: Mechanics.

GROUP 2: Drivers on Euclids, 10 Wheel Tractors and Tractor Trailer Trucks, Low Bed, and Pole Trailers

TEAM0469D 05/01/1997

BURLINGTON (Remainder), MERCER, MONMOUTH, AND OCEAN COUNTIES

TRUCK DRIVERS:

GROUP 1	24.45	10.335+A
GROUP 2	24.50	10.335+A
GROUP 3	24.60	10.335+A
GROUP 4	24.70	10.335+A

FOOTNOTE:

A. Employees working or receiving pay for 80 days within a year receive one week's paid vacation (48 hours); 125 days receive two weeks' vacation (96 hours); 145 days receive 15 days (120 hours); 15 years seniority and 145 days receive 4 weeks vacation (160 hours).

PAID HOLIDAYS: New Year's Day; Washington's Birthday; Memorial Day; Independence Day; Labor Day; Columbus Day; Veteran's Day, General Election Day; Thanksgiving Day; and Christmas Day provided the employee has been assigned to work or "shapes" one day of the calendar week during which the holiday falls. Employee receives \$3.00 per hour premium pay for hazardous waste work.



9 GROUP 5 20.75 8.1875+A+B  
0 GROUP 6 \*

1

2 FOOTNOTES:

3 A. Employee who has worked or received pay for 90 days  
4 within a year prior to his anniversary date shall  
5 receive 56 hours straight time vacation pay; for 3 years  
6 but less than 8 years of service he will receive 100  
7 hours of straight time vacation pay; 15 years or more he  
8 will receive 165 hours of straight time vacation pay.

9 B. PAID HOLIDAYS: New Year's Day, Memorial Day,  
0 Independence Day, Labor Day, Veteran's Day,  
1 Presidential Election Day, Thanksgiving Day, Christmas  
2 Day, and two personal holidays, Good Friday, and  
3 Christmas Eve afternoon (provided employee works that  
4 morning) on the condition that the employee works or is  
5 available for work on at least two days in the week in  
6 which the holiday occurs.

7

8 TRUCK DRIVERS CLASSIFICATIONS

9

0 GROUP 1: Warehouseman

1

2 GROUP 2: Dump truck, water truck, transit mix, pickup, tank,  
3 track, agitator, concrete mobile unit, dytinger bead, tack  
4 rig, ross carrier, warehouse forklift, A-frame, gin pole  
5 form truck, truck having self-loading/unloading attachment,  
6 straight

7

8 GROUP 3: Truckstowing

9

0 GROUP 4: Trailer winch off road dump, fuel, tractor trailer,  
1 asphalt oil distributor, off road water truck

2

3 GROUP 5: Mechanics

4

5 \*GROUP 6: Truck drivers, on hazardous waste removal work on a  
6 state or federally designated hazardous waste site where  
7 the truck driver is in direct contact with hazardous  
8 materials and when personal protective equipment is  
9 required for respiratory, skin and eye protection  
0 the teamster shall receive \$2.25 per hour in addition to  
1 the regular rate of pay including overtime pay.

2 -----

3

4 WELDERS - Receive rate prescribed for craft performing operation  
5 to which welding is incidental.

6 =====

7

8 Unlisted classifications needed for work not included within  
9 the scope of the classifications listed may be added after  
0 award only as provided in the labor standards contract clauses  
1 (29 CFR 5.5(a)(1)(v)).

2 -----

3 In the listing above, the "SU" designation means that rates  
4 listed under that identifier do not reflect collectively  
5 bargained wage and fringe benefit rates. Other designations

6 indicate unions whose rates have been determined to be  
7 prevailing.

8  
9 WAGE DETERMINATION APPEALS PROCESS  
0

1 1.) Has there been an initial decision in the matter? This can  
2 be:

- 3  
4 \* an existing published wage determination  
5 \* a survey underlying a wage determination  
6 \* a Wage and Hour Division letter setting forth a  
7 position on a wage determination matter  
8 \* a conformance (additional classification and rate)  
9 ruling  
0

1 On survey related matters, initial contact, including requests  
2 for summaries of surveys, should be with the Wage and Hour  
3 Regional Office for the area in which the survey was conducted  
4 because those Regional Offices have responsibility for the  
5 Davis-Bacon survey program. If the response from this initial  
6 contact is not satisfactory, then the process described in 2.)  
7 and 3.) should be followed.

8  
9 With regard to any other matter not yet ripe for the formal  
0 process described here, initial contact should be with the Branch  
1 of Construction Wage Determinations. Write to:

2  
3 Branch of Construction Wage Determinations  
4 Wage and Hour Division  
5 U. S. Department of Labor  
6 200 Constitution Avenue, N. W.  
7 Washington, D. C. 20210  
8

9 2.) If the answer to the question in 1.) is yes, then an  
0 interested party (those affected by the action) can request  
1 review and reconsideration from the Wage and Hour Administrator  
2 (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

3  
4 Wage and Hour Administrator  
5 U.S. Department of Labor  
6 200 Constitution Avenue, N. W.  
7 Washington, D. C. 20210  
8

9 The request should be accompanied by a full statement of the  
0 interested party's position and by any information (wage payment  
1 data, project description, area practice material, etc.) that the  
2 requestor considers relevant to the issue.

3  
4 3.) If the decision of the Administrator is not favorable, an  
5 interested party may appeal directly to the Administrative Review  
6 Board (formerly the Wage Appeals Board). Write to:

7  
8 Administrative Review Board  
9 U. S. Department of Labor  
0 200 Constitution Avenue, N. W.  
1 Washington, D. C. 20210  
2



## SECTION 01000

## Description of Bid Items

The general outline of the principal features of the each item as listed above does not in any way limit the responsibility of the bidder for making a through investigation of the drawings and the specifications to determine the scope of work including each item of the bidding schedule.

Descriptions of the bid items are supplemented as follows:

(a) Item No. 0001(1) "Add/Alt. Building 208", includes all work required, within the lines 5 feet outside the building lines, except that work covered by Item No. 0002(1).

(b) Item No. 0002(1) "Site Improvements", includes all work required 5 feet beyond the building lines.

(c) Item No. 0003(1) "OMAR Equipment", includes all work required to furnish and install items indicated as "OMAR funded" on the drawings or in the Specifications. OMAR (Operation and Maintenance Army Reserve) equipment is to be contractor provided and installed.

OMAR funded equipment consists of:

Metal storage Shelving (specification section 10552)  
Wire Mesh Partitions (specifications section 10605)  
Trash & Ash Receptacles (specification section 10990)  
Break Room Refrigerator & Microwave (specification section 11400)  
Telephone Instruments (specification section 16741)

## SECTION 01090

## SOURCES FOR REFERENCE PUBLICATIONS

## PART 1 GENERAL

## 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the sponsoring organization, e.g.

UL 1 (1993; Rev thru Jan 1995) Flexible Metal Conduit. However, when the sponsoring organization has not assigned a number to a document, an identifying number has been assigned for convenience, e.g. UL's unnumbered 1995 edition of their Building Materials Directory is identified as UL-01 (1995) Building Materials Directory. The sponsoring organization number (UL 1) can be distinguished from an assigned identifying number (UL-01) by the lack of a dash mark (-) in the sponsoring organization assigned number.

## 1.2 ORDERING INFORMATION

The addresses of the organizations whose publications are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the sponsoring organization should be ordered from the source by title rather than by number.

## ACI INTERNATIONAL (ACI)

P.O. Box 9094  
Farmington Hills, MI 48333-9094  
Ph: 248-848-3800  
Fax: 248-848-3801  
Internet: <http://www.aci-int.org>

## AGRICULTURAL MARKETING SERVICE (AMS)

Seed Regulatory and Testing Branch  
USDA, AMS, LS Div.  
Room 209, Bldg. 306, BARC-East  
Beltsville, MD 20705-2325  
Ph: 301-504-9430  
Fax: 301-504-5454 Internet: <http://www.ams.usda.gov/lsg/ls-sd.htm>  
e-mail: [james\\_p\\_triplett@usda.gov](mailto:james_p_triplett@usda.gov)

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

4301 North Fairfax Dr., Suite 425  
ATTN: Pubs Dept.  
Arlington, VA 22203  
Ph: 703-524-8800  
Fax: 703-528-3816  
E-mail: [ari@ari.org](mailto:ari@ari.org)  
Internet: [www.ari.org](http://www.ari.org)

## AIR DIFFUSION COUNCIL (ADC)

104 So. Michigan Ave., No. 1500  
Chicago, IL 60603

Ph: 312-201-0101  
 Fax: 312-201-0214

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

30 W. University Dr.  
 Arlington Heights, IL 60004-1893  
 Ph: 708-394-0404  
 Fax: 708-253-0088

ALUMINUM ASSOCIATION (AA)

Pubs Department  
 P.O. Box 753  
 Waldorf, MD 20601  
 Ph: 301-645-0756  
 Fax: 301-843-0159  
 Internet: www.aluminum.org

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 Schaumburg, IL 60173-4268  
 Ph: 847-303-5664  
 Fax: 847-303-5774  
 Internet: www.aamanet.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

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 Washington, DC 20001  
 Ph: 800-231-3475  
 Fax: 800-525-5562  
 Internet: www.aashto.org  
 NOTE: AASHTO documents with numbers beginning with M or T are available only in Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1997 @\$289.00\X

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 Fax: 202-223-4579

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 Cincinnati, OH 45240  
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 Fax: 513-742-3355

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Fax: 708-934-8803

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Publications: 800-644-2400  
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Fax: 610-832-9555  
Internet: [www.astm.org](http://www.astm.org)  
NOTE: The annual ASTM Book of Standards (66 Vol) is  
available for \$3500.00. Prices of individual standards vary.

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e-mail: [marketing@asce.org](mailto:marketing@asce.org)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

1791 Tullie Cir., NE  
Atlanta, GA 30329-2305  
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Fax: 404-321-5478  
Internet: <http://www.ashrae.org>

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

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Fax: 216-835-3488  
E-mail: asse@ix.netcom.com

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

6666 West Quincy  
Denver, CO 80235  
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## AMERICAN WELDING SOCIETY (AWS)

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## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

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Fax: 817-326-6306  
NOTE: AWPA Book of Standards is published yearly @\$75.00;  
individual standards may be ordered separately for \$12.00 to  
\$28.00 each.

## APA - THE ENGINEERED WOOD ASSOCIATION (APA)

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Fax: 770-423-1703  
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## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

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Fax: 703-733-0584  
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## ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

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Fax: 703-412-1152

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 Fax: 202-638-4833

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 Fax: 205-257-2540  
 Internet: <http://www.aeic.org/index.htm>  
 E-Mail: [veazey-white@apc.com](mailto:veazey-white@apc.com)

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Fax: 601-634-2506  
NOTE: COE Handbook for Concrete and Cement (Documents w/prefix  
CRD-C) (1949-present; 2 Vol) free to Government offices; \$10.00  
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Fax: 205-988-9822  
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E-mail: [info@dipra.org](mailto:info@dipra.org)

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Fax: 508-394-1194  
E-mail: [www.electricnet.com/orgs/insucbl.htm](http://www.electricnet.com/orgs/insucbl.htm)

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P.O. Box 12277  
Research Triangle Park, NC 27709  
Ph: 919-549-8411  
Fax: 919-549-8288  
e-mail: [ISA@isa.org](mailto:ISA@isa.org)  
Internet: <http://www.isa.org>

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Fax: 703-620-6530  
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INDUSTRY (MSS)

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Vienna, VA 22180-4602  
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Fax: 810-476-1630

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Fax: 216-241-0105

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Fax: 703-237-7442

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Fax: 800-593-6372  
Internet: <http://www.nfpa.org>  
NOTE: The complete set of 1997 NFPA National Fire Codes (13 Vol.)  
is available for \$835.00.

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Memphis, TN 38184-0518  
Ph: 901-377-1818  
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-- End of Section --

## SECTION 01300

## SUBMITTAL PROCEDURES

## PART 1 GENERAL

## 1.1 SUMMARY

This section covers procedures to be used in making submittals called for in the contract documents. In contracts which contain specific "Contractor Quality Control" requirements, the Contractor's Quality Control Representative shall carry out duties associated with submittal procedures. In contract which do not contain specific CQC requirements, reference to "CQC Representative" shall be interpreted as reference to the Contractor's authorized representative, and references to "CQC Requirements" or "CQC Clauses" shall be interpreted as "requirements or clauses elsewhere in the contract."

## 1.2 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers as follows:

SD-01 Data

SD-04 Drawings

SD-06 Instructions

SD-07 Schedules

SD-08 Statements

SD-09 Reports

SD-13 Certificates

SD-14 Samples

SD-18 Records

SD-19 Operation and Maintenance Manuals

## 1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

## 1.3.1 Government Approved (GA)

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

### 1.3.2 Information Only (FIO)

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

### 1.4 REVIEWER CODES

Reviewer codes on the Submittal Register (ENG Form 4288) are identified as follows:

A - Area Engineer

E - Engineering (Design Branch)

AE- Architect/Engineer

### 1.5 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

### 1.6 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

### 1.7 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready

determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

### 3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of this section is one set of ENG Form 4288 listing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. Columns "d" through "r" have been completed by the Government; the Contractor shall complete columns "a" and "s" through "u" and submit the forms (hard copy plus associated electronic file) to the Contracting Officer for approval within 30 calendar days after Notice to Proceed (15 days if construction time is 180 days or less). If the Government supplies the ENG Form 4288 on the Resident Management System (RMS) electronic format, the contractor will be required to process and update the 4288 electronically, and make appropriate electronic submissions to the Government. Otherwise, the Contractor will be given the submittal register as a diskette containing the computerized ENG Form 4288 and instructions on the use of the diskette. In both cases, the Contractor shall update the 4288 electronically, and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated.

### 3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 10 calendar days shall be allowed and shown on the register for review and approval of submittals for food service equipment, refrigeration and HVAC control systems, computer software for specialty systems, electrical substations, and studies including electrical system coordination studies.

### 3.4 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be

properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item. If the contractor is required in another section of the specifications to utilize the RMS system, the contractor will be required to generate and process this form electronically using the RMS system.

### 3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

#### 3.5.1 Procedures

At the Quality Control Coordination meeting, or preconstruction conference, the Contractor shall ascertain the name and address of each individual, agency, or firm who is designated to normally receive items for approval, for information or samples. The contractor shall complete ENG Form 4025, entering each item requiring a separate approval action as a separate item on the form, for each transmittal. A transmittal may consist of one or more 4025 sheets. The transmittal, consisting of ENG Form 4025 plus all applicable submittals, is then sent to the appropriate individual. On critical items the Contractor is encouraged to confirm receipt via telephone. The Contractor shall submit seven copies of submittals for approval and one for items for information.

#### 3.5.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

### 3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control its procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

### 3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four copies of the submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

### 3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring

removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR  (Firm Name)
  _____ Approved
  _____ Approved with corrections as noted on submittal data and/or attached sheets(s).
SIGNATURE: _____
TITLE: _____
DATE: _____

SECTION 01310

PROJECT SCHEDULE:  
NETWORK ANALYSIS SYSTEM

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-07 Schedules

Initial Project Schedule; GA. Preliminary Project Schedule; GA. Periodic Schedule Updates; GA.

Four copies of the schedules showing codes, values, categories, numbers, items, etc., as required.

SD-08 Statements

Qualifications; FIO.

Documentation showing qualifications of personnel preparing schedule reports.

SD-09 Reports

Narrative Report; FIO. Schedule Reports; FIO.

Four copies of the reports showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports. This person shall have previously created and reviewed computerized schedules. Qualifications of this individual shall be submitted to the Contracting Officer for review with the Preliminary Project Schedule submission.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project should also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid

in evaluating time extensions, and to provide the basis of all progress payments.

### 3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel shall result in an inability of the Contracting Officer to evaluate Contractor progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

### 3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

#### 3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in either the Precedence Diagram Method (PDM) or the Arrow Diagram Method (ADM).

#### 3.3.2 Level of Detail Required

With the exception of the initial and preliminary schedule submission, the Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

##### 3.3.2.1 Activity Durations

Contractor submissions shall be required to follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods. A rule of thumb, that the Contractor should use, is that less than 2 percent of all non-procurement activities' Original Durations shall be greater than 20 days.

##### 3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

### 3.3.2.3 Government Activities

Government and other agencies activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and notice to proceed for phasing requirements.

### 3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

### 3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

### 3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number.

### 3.3.2.8 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

### 3.3.2.9 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not be allowed to contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

### 3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

## 3.3.3 Scheduled Project Completion

The schedule interval shall extend from notice-to-proceed to the contract completion date.

### 3.3.3.1 Project Start Date

The schedule shall start no earlier than the date that the Notice to Proceed (NTP) was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have: a "ES" constraint, a constraint date

equal to the date that the NTP was acknowledged, and a zero day duration.

### 3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity call "End Project". The "End Project" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

### 3.3.3.3 Early Project Completion

In the event the project schedule shows completion, the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted at every project schedule update period to assist the Contracting Officer to evaluate the Contractor's ability to actually complete prior to the contract period.

### 3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

#### 3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have: a "ES" constraint, a constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

#### 3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

#### 3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X:" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

### 3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in progress or completed activity and insure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes.

### 3.3.6 Out-of-Sequence Progress

Activities that have posted progress without predecessors being completed (Out-of-Sequence Progress) shall be allowed only by the case-by-case approval of the Contracting Officer. The Contracting Officer may direct that changes in schedule logic be made to correct any or all out-of-sequence work.

### 3.3.7 Extended Non-Work Periods

Designation of Holidays to account for non-work periods of over 5 days shall not be allowed. Non-work periods of over 5 days shall be identified by addition of activities that represent the delays. Modifications to the logic of the project schedule shall be made to link those activities that may have been impacted by the delays to the newly added delay activities.

### 3.3.8 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

## 3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

### 3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 10 calendar days after Notice to Proceed is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after Notice to Proceed.

### 3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after Notice to Proceed. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

### 3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer or to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

## 3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the initial submission, and every periodic project schedule update throughout the life of the project:

### 3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on

the disks shall be in the format specified in Appendix A, " Standard Data Exchange Format".

#### 3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the MS-DOS Version 5.0 operating system.

#### 3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the MS-DOS version used to format the disk.

#### 3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will insure that the names of the files submitted are unique. the Contractor shall submit the file naming convention to the Contracting Officer for approval.

#### 3.5.2 Narrative Report

A Narrative Report shall be provided with each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 4 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken.

#### 3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

#### 3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in-progress or completed.

##### 3.5.4.1 Activity Report

A list of all activities sorted according to activity number or "I-NODE" AND "J-NODE" and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

##### 3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

##### 3.5.4.3 Total Float Report

A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates.

#### 3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: [Activity Number] [or] ["i-node" and "j-node"], Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), Earnings to Date.

#### 3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on bi-monthly (60 days) schedule update submissions. In addition to other submission requirements, a single mylar reproduceable 20 inch by 30 inch size shall be submitted. The diagram shall also The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

##### 3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram.

##### 3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

##### 3.5.5.3 Critical Path

The critical path shall be clearly shown.

##### 3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

##### 3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

#### 3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly on-site meeting or other regular intervals mutually agreed to at the

preconstruction conference. During this meeting the Contractor will describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

### 3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

### 3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

### 3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost to Date shall be subject to the approval of the Contracting Officer. The following minimum set of items which the Contractor shall address, on an activity by activity basis, during each progress meeting.

#### 3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed activities.

#### 3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations must be based on Remaining Duration for each activity.

#### 3.6.3.3 Cost Completion

The earnings for each activity started. Payment shall be based on earnings for each in-progress or completed activity. Payment for individual activities shall not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

#### 3.6.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, [lag durations,] and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

#### 3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities are those delays beyond the Contractors control such as strikes and unusual weather. Also included are delays encountered due to submittals, Government Activities, deliveries or work stoppage which makes re-planning the work necessary, and when the schedule does not represent the actual prosecution and progress of the work.

### 3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, he shall furnish such justification, project schedule data and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

#### 3.7.1 Justification of Delay

The project schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved with this request.

The Contracting Officer's determination as to the number of allowable days of contract extension, shall be based upon the project schedule updates in effect for the time period in question and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, shall not be a cause for a time extension to the contract completion date.

#### 3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under two weeks based upon the most recent schedule update at the time of the Notice to Proceed or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.
- d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

#### 3.7.3 Additional Submission Requirements

For any request for time extension for over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

### 3.8 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until the Contractor submits revisions, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, then the Contractor shall

advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor will continue to update their schedule with the Contracting Officer's revisions until a mutual agreement in the revisions may be made. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

### 3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

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(((ADD pages A1 through A14 "STANDARD DATA EXCHANGE FORMAT" from ER 1-1-11))))

## SECTION 01356

## STORM WATER POLLUTION PREVENTION MEASURES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 4439	(1995) Standard Terminology for Geotextiles
ASTM D 4491	(1992) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(1995) Identification, Storage, and Handling of Geotextiles

## 1.2 GENERAL

The Contractor shall implement the storm water pollution prevention measures specified in this section in a manner which will meet the requirements of Section 01354 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit attached to that Section, the Burlington County Conservation District Soil Erosion and Sediment Control Permit, and other permits listed in Section 01354.

## 1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Mill Certificate or Affidavit; FIO.

## 1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

## 1.4.1 Stabilization Practices

The stabilization practices to be implemented shall include temporary

seeding, mulching, geotextiles, erosion control mats, protection of trees, etc. On his daily CQC Report, the Contractor shall record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

#### 1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

#### 1.4.1.2 No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the fourteenth day after construction activity temporarily ceased.

#### 1.4.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices. Location and details of installation and construction are shown on the drawings.

##### 1.4.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fences shall be installed in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Contracting Officer.

##### 1.4.2.2 Straw Bales

The Contractor shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in a area between a ridge and drain, bales shall be placed as work progresses, bales shall be removed/replaced/relocated as needed for work to progress in the drainage area). Areas where straw bales are to be used are shown on the drawings. Final removal of straw bale barriers shall be upon approval by the Contracting Officer. Rows of bales of straw shall be provided as follows:

- a. Along the downhill perimeter edge of all areas disturbed.
- b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.

c. Along the toe of all cut slopes and fill slopes of the construction areas.

1.4.2.3 General Erosion Control

The Contractor shall install rock check dams, sandbag dams, desilting devices, and other erosion control measures as shown and detailed on the drawings and as detailed in the Erosion and Sediment Control Plan. The contractor may use similar or alternate devices if approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (%)		30 % max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

#### 2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

#### 2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, or rice, furnished in air dry condition. The bales shall have a standard cross section of 14 inches by 18 inches. All bales shall be either wire-bound or string-tied. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet.

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 24 inches above the ground surface. Filter fabric shall be from in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 6 inches wide and 6 inches deep on the upslope side of the location of the silt fence. The 6-inch by 6-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

#### 3.2 INSTALLATION OF STRAW BALES

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

#### 3.3 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

##### 3.3.1 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade.

### 3.3.2 Straw Bale Maintenance

Straw bale barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales. Necessary repairs to barriers or replacement of bales shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier.

Bale rows used to retain sediment shall be turned uphill at each end of each row. When a straw bale barrier is no longer required, it shall be removed. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 02921 SEEDING.

## 3.4 INSPECTIONS

### 3.4.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

### 3.4.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

### 3.4.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

## SECTION 01410

## ENVIRONMENT PROTECTION

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS.

## SD-08 Statements

## Environmental Protection Program; GA.

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall submit in writing his detailed proposal for implementing requirements for environmental pollution control specified herein.

## Preconstruction Survey; FIO.

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey, after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access routes(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.

## Waste Disposal Scheme; FIO.

As part of his proposed implementation under Paragraph 3.2, and prior to onsite construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is dumped in unauthorized area, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 GENERAL

The Contractor shall perform all work in such manner as to minimize the pollution of air, water, or land, and shall, within reasonable limits,

control noise and the disposal of solid waste materials, as well as other pollutants.

### 3.2 IMPLEMENTATION

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall meet the representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.

### 3.3 PROTECTION OF LAND AREAS

Except for any work on storage areas and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURE, UTILITIES AND IMPROVEMENTS, be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSE: OPERATIONS AND STORAGE AREAS, storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contractor Officer.

### 3.4 PROTECTION OF TREES AND SHRUBS

CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES AND IMPROVEMENTS, is hereby supplemented as follows: The Contractor shall not deface, injure or destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage.

#### 3.4.1 Tree Protective Structures

Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, plans, or poles around them.

#### 3.4.2 Restoration of Damaged Trees

Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on trees not designated on the plans to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor so as to be beyond saving in the opinion of the Contracting Officer, shall be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.

### 3.5 PROTECTION OF WATER RESOURCES

The Contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids, or harmful materials, both on and off the Government

premises, and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides from entering public waters. Water used in onsite material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result therefrom.

3.6 NOT USED

3.7 NOT USED

### 3.8 DUST CONTROL

The Contractor shall maintain all excavations, stockpiles, access roads, waste areas, and all other work free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

### 3.9 EROSION CONTROL

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations, should be held to a minimum.

3.10 NOT USED

### 3.11 CORRECTIVE ACTION

The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

### 3.12 POST-CONSTRUCTION CLEANUP OR OBLITERATION

In accordance with CONTRACT CLAUSE: CLEANING UP, the Contractor shall, unless other wise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed areas shall be graded and filled and the entire area seeded.

3.13 PAYMENT

No separate payment or direct payment will be made for the cost of the work covered under this section, and such work will be considered as a subsidiary obligation of the Contractor.

-- End of Section --

## SECTION 01450

## TESTING FOR MECHANICAL AND ELECTRICAL SYSTEMS

## 1. Applicability.

This section applies to all mechanical and electrical systems and all systems using electromagnetically driven equipment, pneumatic or electronic systems; high and low voltage electrical distribution systems (except branch panels) and to any system which incorporates this section into other parts of the specification by reference. For purposes of this section a "system" is an entity comprised of a series of closely related interdependent components and which is capable of independent performance of a useful function. System components shall include all software and programming as applicable for the system. Some typical examples include:

- a. Independently functioning HVAC Systems.
- b. Fire Alarm Systems.
- c. Public Address Systems.
- d. Sprinkler Systems including alarms.
- e. Telephone Systems including line protectors, splices cables, switching equipment, outlets and instruments.
- f. Intrusion Detection System.
- g. High Voltage Equipment including cable, splices, switchgear, relays, circuit breakers, fuses, transformers, instrumentation, etc.
- h. Low Voltage Switchboard including incoming and outgoing feeders, circuit protection and all accessories.

## 2. Test Plan.

a. Not later than sixty days after Notice to Proceed, in accordance with Section "Submittals" and other paragraphs of the technical provisions, the Contractor shall submit a list for approval consisting of all systems for which test plans are required. This list will be reviewed by the Government and any systems found to be missing will be required to be added by the Contractor, and appropriate test plans submitted. No work will be permitted on any of the above systems until this list is submitted.

b. The Contractor shall develop test plans and schedule operational testing for the systems in the approved list. The testing shall be in accordance with the requirements in the appropriate technical provisions and shall include as a minimum the requirements below. All testing required by applicable codes, standards, utility companies, manufacturers, suppliers, etc. shall be incorporated into the Contractor's test plans. Test plans shall list all equipment required to perform the tests, and any Government support required. All fire protection system acceptance tests must be witnessed by the Fort Dix Fire Prevention Bureau. It shall be in sufficient detail to permit a step-by step approach to the test and to demonstrate that the systems operate as intended by the contract documents. It shall describe as a minimum:

1. What system is being tested including a listing of all components to be tested.

2. What individual or organization will perform testing, who will certify the tests, and qualifications of test personnel.

3. A step by step narrative of the testing procedure to be used to demonstrate contract compliance including all governing standards, such as "sequence of controls", "ASTM Standard XXX"; or IEEE Standard XXX", etc.

4. What testing equipment will be utilized.

5. What operator interaction is required.

6. What results are to be expected.

7. Seasonal limitations, if any, including date(s) of proposed testing.

8. A complete schematic diagram (electrical, pneumatic) showing all components, and block diagram.

9. A checklist shall be developed to be used during the operational test.

c. Test plans shall be submitted for approval for all systems contained on the list submitted per para. 2a above. It is also desirable to submit all test plans as soon as possible so that the progress of the project and corresponding payments will proceed on schedule.

3. Testing Process. Outlined below are a number of events relating to the status of the test plan and testing. The corresponding percentages indicate the maximum percentage of the value of the system which will be permitted to be installed after the successful completion of the corresponding event indicated, for all systems to which this section applies. Events must be completed sequentially. Any work performed in excess of the permitted percentages will be at the Contractor's own risk and will not be paid until the event corresponding to the percentage of system value permitted to be installed is successfully completed:

EVENT	MAX. % of SYSTEM VALUE PERMITTED TO BE INSTALLED
1. Contractor has submitted list of systems that require test plans to be approved, and system work is ongoing but no test plan submitted.	50
2. Test Plan Submitted	65
3. *Test Plan Approved	80
4. Successful completion of tests including submission of required documents, reports (i.e. balancing reports for all HVAC Systems), Operation and Maintenance Manuals spare parts, and spare parts data.	**100

\* The Government will process the submittal in accordance with the time frames indicated in the specification section "Submittals". If the test plan is disapproved the Government has an additional 30 days to review the resubmittal from the date it receives the resubmittal.

\*\*If a system involves both heating and cooling modes and one mode has been successfully tested this percentage shall be reduced to 90% until the testing is completed.

b. The Contractor may proceed with events as indicated in the above table for each system separately.

4. Operational tests including performance tests shall be conducted for an entire system, not component parts only. Tests may be conducted only after an entire system has been completely installed. Contractor shall provide a minimum of 14 days notice to the Contracting Officer of scheduled tests. This notice must include the Contractor's assurance that all installed work previously identified to the Contractor as being unacceptable along with all remaining work associated with the respective system will be complete and acceptable by the date scheduled for the operational test. Failure of the Contractor to have all contract work acceptably complete for this test will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection costs.

5. For each system the Contractor shall obtain the services of an experienced professional who shall certify that the operational test was conducted in accordance with the approved test plan and the results of this test meet all the contract requirements. These individuals must have a minimum of eight years experience in the testing of the particular system being tested and shall also meet qualifications (if any) set forth in other technical sections of the contract specifications.

6. When considering the value of a system for payment purposes the following components shall be counted as part of a "system": All electro-magnetically driven equipment; pneumatic or electric control system; gauges, dampers, valves, actuators, controllers, pipes, test sensing elements, logic/processors, CPU's, ducts, insulation, wiring, conduit, switchgear, and all other mechanical or electrical components, devices or equipment which are essential to the proper function of the system such as pumps, motors, air-handling units, chillers, cooling towers, etc. Software programs and any refrigerants are also considered "parts" of a system.

7. The requirements contained in this section supplement other testing requirements contained in the contract documents. If a conflict exists between the requirements of this section and other parts of the contract documents, the requirements of this section shall take precedence.

## SECTION 01451

### CONTRACTOR QUALITY CONTROL

(NYD EDITION 3/98)

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740 (1996) Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1995b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

##### 1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and off site, and shall be keyed to the proposed construction sequence. For purposes of this section the term "construction" shall include all activities relating to the erection of buildings, roads, infrastructure, flood control structures, or activities relating to dredging and disposal, demolition, hazardous and toxic waste removal, etc., as indicated in the contract documents. Other sections of the contract documents may also require separate, specially qualified individuals in such areas as chemical data acquisition, sampling and analysis, medical monitoring, industrial hygiene, safety officer, etc. The CQC organization will coordinate the activities of these individuals. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

##### 3.2 QUALITY CONTROL PLAN

###### 3.2.1 General

The Contractor shall furnish for review by the Government, not later than 90 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause entitled "Inspection of Construction." The plan shall identify personnel, procedures,

control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 90 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

### 3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and off site, including work by subcontractors, fabricator, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Clear indication that CQC System Manager will have no duties other than Quality Control.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters will also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off site fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.) The Contractor shall incorporate all tests required by the contract (including systems commissioning and operating tests) to derive the above list of testing information which shall be presented in matrix form as part of the CQC Plan. This matrix shall be suitable for use by the Contractor and the Government as a checklist to control testing to be done on the contract. Coordinate any additional test submission or plan requirements for Mechanical and Electrical Systems with appropriate specialized specification section if applicable.

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation. Provide matrix of Preparatory and Initial Inspections including specification reference paragraph, the name of the Definable Feature of Work, and spaces for date performed, results, and names of attendees.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section. This list will cover all features of work on the project, and will be agreed upon during the coordination meeting.

j. A brief explanation of the duties of the CQC organization with respect

To safety. Note that separate Accident Prevention Plan and Hazards Analysis is required for submission and acceptance.

- k. Contractor's plan for training all CQC personnel in the CQC System.

### 3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

### 3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

## 3.3 COORDINATION MEETING

After the Pre-construction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 calendar days prior to the Coordination Meeting. The initial plan submitted must be found acceptable by the Government before the Coordination Meeting can be held. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and off site work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

## 3.4 QUALITY CONTROL ORGANIZATION

### 3.4.1 General

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure contract compliance. The number of CQC personnel shall be increased as required during times of high construction workload. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Contracting Officer.

### 3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, or shall hold a state Professional Engineer's license, with a minimum of 2 years construction experience on construction similar to this contract, one year of which as a Quality Control Representative. The CQC Manager may also be a construction person with a minimum of 4 years in related work, one year of which as a QC Representative. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager. The CQC System Manager shall be assigned no duties other than Quality Control.

### 3.4.3 Organizational Expertise

The CQC organization, which includes the CQC System Manager and additional qualified personnel, must as a minimum possess general corporate technical knowledge of all aspects of the project, and must successfully execute the CQC System on all aspects of the project. Individuals possessing experience in specialized areas shall be added to the organization as required during periods when such specialty areas are being executed. Examples of such specialized areas would include HVAC, electrical distribution and substations, roofing, tele-communication systems, fire protection and alarm systems, computer installations, specialized welding, specialized finishes, precast concrete installation, modular housing, specialized geotech work, dredging, sand placement and surveying, chemical data acquisition, hazardous material removal and disposal, medical monitoring, etc., depending on the nature of the particular project. The Contractor must demonstrate that such additional qualified personnel have received sufficient training and indoctrination into the CQC system, and that these personnel properly execute the requirements of the CQC System within their areas of expertise.

#### 3.4.4 Additional Requirement

In addition to the above experience and education requirements the CQC System Manager shall have completed within the last five years the course entitled "Construction Quality Management for Contractors". This course is given at a cost of \$25 by Government personnel and is of two- day duration. The Government will provide one instruction manual for the course.

#### 3.4.5 Organizational Changes

The Contractor shall maintain the CQC Organization at full strength at all times. When it is necessary to make changes to the organization, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

### 3.5 SUBMITTALS

Submittals shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements and are submitted in accordance with the date on the submittal register. CQC personnel shall also make physical checks of materials and equipment before installation to insure compliance with approved shop drawings.

### 3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

#### 3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the worksite, and shall include:

- a. A review of each paragraph of applicable specifications.
- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met per EM 385-1-1, "Safety and Health Requirements Manual".

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase meeting. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall clearly indicate its intent and plan for communication of the results of the preparatory phase to applicable workers, to include materials, construction methods, workmanship standards, safety considerations and procedures, and preparatory phase meeting minutes.

### 3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work (DFW) when the accomplishment of a representative sample of the work is impending.

The following shall be accomplished:

a. A check of the portion of work done to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase meeting. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), the foreman responsible for the definable feature and the work crew(s) for the appropriate DFW. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location (i.e. CQC Report number) of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

### 3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which

may be affected by the deficient work. The Contractor shall not build upon or conceal non-conforming work.

#### 3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable feature of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

#### 3.6.5 Definable Feature of Work: Definition and Discussion

A Definable Feature of Work (DFW) is a portion of work consisting of materials, equipment, supplies and procedures which are closely related to each other, have the same control and will be accomplished by the same work crew to completion. A DFW must be sufficiently small so that control of the work (i.e. communication of requirements to workers, inspection of materials and workmanship and correction of deficiencies) will be easily accomplished. Some examples are:

- \* Rough-in of electrical boxes and wiring methods
- \* Lighting fixtures, receptacles, and accessories
- \* Panelboards, circuit breakers and motors.
- \* Water supply piping, fittings and supports
- \* DWV piping, fittings and supports for plumbing
- \* Concrete reinforcement and formwork
- \* Concrete mixing, placement, curing and finishing
- \* Testing Procedure for contaminated soil, materials and storage tank contents
- \* Storage Tank disassembly and removal
- \* Setting up of decontamination area, exclusion zones and standard safety procedures for asbestos removal
- \* Asbestos removal and disposal procedures
- \* Chemical Data Acquisition
- \* Preparation, removal and disposal of contaminated material
- \* Dredging and placement.

### 3.7 TESTS

#### 3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a laboratory which has been assurance inspected by the Corps of Engineers within the last two years. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.

- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, will be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an off site or commercial test facility will be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.7.2 Testing Laboratories

#### 3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment and calibration in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, aggregate and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329. The Government will perform an assurance inspection of the laboratory which the contractor proposes to perform tests on soils, concrete, asphalt,

#### 3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$1500 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

### 3.7.3 On-Site Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

### 3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, as designated by the Government Representative. Coordination for each specific test, exact delivery location and dates will be made through the Area Office.

## 3.8 COMPLETION INSPECTION

### 3.8.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the Government that the facility is ready for the Government's "Pre-final" inspection.

### 3.8.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is ready to be occupied. A Government "Pre-final Punch List" will be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected and so notify the Government so that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

### 3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person and the contracting Officer's representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final Inspection. Notice will be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being acceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause entitled "Inspection of Construction".

## 3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals reviewed, with contract reference, by whom, and action taken.
- g. Off-site surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. "N/A" shall be entered

into any field for which no entry is intended. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 16 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. All documentation is expected to be literate, legible and complete.

### 3.10 SAMPLE FORMS

(Note: If the Resident Management System (RMS) is required to be used by the contractor for the QC System as indicated elsewhere in this contract, Contractor will generate all reports in the RMS System, and attached forms will serve as guidance only. Otherwise forms contained herein will be used by the by CQC Staff for CQC System reporting ).

a. The 2-page form at the end of the section will be used for the basic CQC Report. CQC personnel shall attach continuation sheets as required for any entries which cannot fit on the basic form. Preparatory and Initial Inspections, when performed, shall be indicated on the basic CQC report and minutes for each inspection shall be attached. Minutes will consist of a list of specific requirements for materials, procedures or equipment to be employed and shall also include any understandings reached or items of special importance discussed.

b. In addition, outstanding deficiencies shall be listed on the form "List of Outstanding Deficiencies" at the end of this section and shall be attached to each CQC report. As deficiencies are corrected, they are to be acknowledged on the basic CQC report and shall be deleted from the list.

c. Form at the end of this section entitled "CQC Test Report List" shall be used by the Contractor to track testing to be done as the project progresses, and also to summarize the Contractor's Quality Control testing to be reported on the CQC Plan.

d. Form "Record of Preparatory and Initial Inspections" at the end of this section shall be used by the Contractor to track Preparatory and Initial inspections as the project progresses and also to summarize these required inspections as part of the CQC Plan.

e. Additional reporting forms pertaining to specialized activities may be included herein or elsewhere in the contract, and shall be used for reporting as indicated.

### 3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor. Deficiencies cited and verbal instructions given to the Contractor by the Government Representative shall be entered into that day's CQC Report.

(FORMS FOLLOW)

-- End of Section --



## SECTION 01500

## TEMPORARY CONSTRUCTION FACILITIES

## 1.1 GENERAL REQUIREMENTS

## 1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

## 1.1.2 Not

## 1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

## 1.2 NOT USED.

## 1.3 NOT USED

## 1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

## 1.4.1 Not Used

## 1.4.2 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

## 1.5 NOT USED

1.6 NOT USED.

1.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 1.1 m 42 inches high, supported and tightly secured to steel posts located on maximum 3 m 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.9 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.10 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

PART 2 NOT APPLICABLE

PART 3 NOT APPLICABLE

---End of Section---

## SECTION 01740

## CONTRACTOR WARRANTY MANAGEMENT

## 1. References:

- a. Clause "Warranty of Construction", (FAR 52.246-0021)
- b. Clause "Inspection of Construction" (FAR 52.246-12)
- c. Special Requirement paragraph entitled "Record Drawings"
- d. Specification Section entitled "Contractor Quality Control"

2. General: In order to insure that the Government systematically receives all warranties of construction, equipment and systems to which it is entitled, the contractor shall execute all actions as required by above references and as contained herein.

3. Post-Completion Inspections: For purposes of management of construction warranties, the Government conducts four and nine month warranty inspections with using agencies. The Contractor is encouraged to attend these inspections in order to better manage any warranty items for which it may be responsible.

4. Tagging of Extended Warranty Items: The Contractor shall install tags to identify items protected by extended warranty, i.e. longer than the one year general warranty of construction. The tags shall be minimum 3 inches by 5 inches in size, machine-printed in minimum 14-point type, and shall be weatherproof. Tags shall be attached to equipment if accessible or to accessible control panel, etc. As a minimum, tags shall indicate the following information:

"Extended Warranty Item:"

Name of Item  
Name of System with which associated, number designation within system, or other identifier  
Model Number  
Serial Number  
Start and end Dates of Warranty  
Contract number  
Contract Name  
Contractor Name  
Point of Contact name, organization and telephone number.

5. Posting of Instructions: In addition to any posting of operating procedures as may be required elsewhere in this contract, any equipment or system for which proper operation or maintenance is critical in order to preserve warranties, prevent damage, or for reasons of safety shall have proper operating procedures posted near the equipment or near the operating point. Instructions shall be protected by 1/16 inch thick plastic sheet. As a minimum such equipment or system shall include:

Electrical Substations  
Transformers

## Electrical Generators

Major HVAC System components including chillers, air-handlers, fans, etc.

HVAC Control Panel

Boilers

Air Compressors

6. Warranty Meeting. At least 14 days prior to the 80% completion point of this contract (or deliverable phase thereof ), the contractor will notify the Government representative for the purpose of scheduling a meeting to clarify understandings of responsibilities with respect to warranties to which the Government is entitled. The Government and contractor shall attend the warranty meeting, as well as any subcontractors, or suppliers involved in the warranty process. The Warranty Plan (below) shall have already been submitted and approved by the Government before the warranty meeting can take place, and shall be the basis of the meeting's agenda.

7. Warranty Plan. At least 30 days before the planned warranty meeting, the contractor shall submit a warranty plan for Government approval per section "Submittals". The Warranty Plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. As a minimum the plan shall indicate:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the contractor's, subcontractors or suppliers involved.

b. Listing and status of O&M manuals and As-built drawings, and expected delivery dates.

c. Listing and status of all training to be provided to Government personnel, whether specified by contract or required by manufacturers.

d. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

e. A list for each warranted equipment, item, feature of construction or system indicating:

Name of item

Model and serial numbers.

Location where installed

Names of manufacturers or, suppliers and phone numbers.

Names addresses and telephone numbers of sources of spare parts

Warranties and terms of warranty. This shall include one-year overall warranty of construction as required by ref. 1.a. Clearly indicate which items have extended warranties.

Cross-reference to warranty certificates as applicable

Starting point and duration of warranty period.

Summary of maintenance procedures required to continue the warranty in force.

Cross-reference to specific pertinent Operation and Maintenance manuals  
Organization, names and phone numbers of persons to call for warranty service  
Typical response time and repair time expected for various warranted equipment

f. The contractor's plans for attendance at the Four and Nine month post-construction warranty inspections conducted by the Government.

g. Procedure and status of tagging of all equipment covered by extended warranties.

h. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons

-- End of Section --

SECTION 02230  
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-18 Records

Materials Other Than Salable Timber; FIO.

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the final surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and

compacted to make the surface conform with the original adjacent surface of the ground.

### 3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

### 3.4 DISPOSAL OF MATERIALS

#### 3.4.1 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths, and stockpiled at locations as directed. The disposal of the stockpiled timber will be by the Government.

#### 3.4.1 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

## SECTION 02300

## EARTHWORK

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1140	(1992) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT)

NJDOT	Standard Specifications for Road and Bridge Construction (Current Edition)
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## 1.2 NOT USED

## 1.3 NOT USED

## 1.4 DEFINITIONS

## 1.4.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SM, SW-SM, and SP-SM. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements and railroads which shall be comprised of stones less than 3 inches in any dimension.

#### 1.4.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

#### 1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

#### 1.4.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density.

#### 1.4.5 NOT USED

#### 1.4.6 Topsoil

Material suitable for topsoils obtained from offsite areas where needed and excavations with a high organic content and meeting New Jersey DOT (NJDOT) Specifications Section 909.10.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-08 Statements

Earthwork; GA.

Procedure and location for disposal of unused satisfactory material.  
Proposed source of borrow material.

#### SD-09 Reports

Testing; GA.

Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests.

#### SD-13 Certificates

Testing; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

## SD-18 Records

Earthwork; FIO.

Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

## 1.6 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings. The subsoil investigation report may be examined at the offices of the Contracting Officer. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

## 1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

## 1.8 BLASTING

Blasting will not be permitted.

## 1.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

## 3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 4 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

## 3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with

the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas.

During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

### 3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

### 3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

### 3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown or from other approved sources, either private or within the limits of the project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

### 3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise

disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

### 3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

### 3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02720 STORM-DRAINAGE SYSTEM; and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

#### 3.7.1 General Requirements

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 8 inches; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

#### 3.7.2 Frozen Material

Embankment shall not be placed on a foundation which contains frozen material, or which has been subjected to freeze-thaw action. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades (whether in an excavation or on an embankment) and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, winter shutdowns, or earthwork operations, shall be removed to a depth that is acceptable to the Contracting Officer and replaced with new material. Alternatively, the material will be thawed, dried, reworked, and recompacted to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill shall cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for his determination. Embankment material shall

not contain frozen clumps of soil, snow, or ice.

### 3.8 EMBANKMENTS

#### 3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.9 SUBGRADE PREPARATION

#### 3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1 inch when tested with a 10 foot straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finish subgrade shall not vary more than 0.05 foot from the established grade and cross section.

#### 3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, each layer of the embankment shall be compacted to at least 90 percent of laboratory maximum density.

##### 3.9.2.1 NOT USED

##### 3.9.2.2 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density. When more than one soil classification is present in the subgrade, the top 12 inches of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

##### 3.9.2.3 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 92 percentage laboratory maximum density for the full depth of the shoulder.

### 3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

### 3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turving materials.

### 3.12 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 4 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

### 3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. The first inspection will be at the expense of the Government. Cost incurred for any subsequent inspections required because of failure of the first inspection will be charged to the Contractor. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922 based upon the recommendation of the testing laboratory. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state

that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

#### 3.13.1 Fill and Backfill Material Gradation

One test per 750 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140.

#### 3.13.2 In-Place Densities

- a. One test per 750 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. One test per 250 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

#### 3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

- a. One check test per lift for each 3000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. One check test per lift for each 1000 square feet, of fill or backfill areas compacted by hand-operated machines.

#### 3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

#### 3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 750 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

#### 3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

#### 3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be

placed on a muddy, spongy, or frozen subgrade.

-- End of Section --

## SECTION 02315

## EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## 1.2 DEGREE OF COMPACTION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, abbreviated as percent laboratory maximum density.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Testing; GA.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SM, SW-SM, and SP-SM.

#### 2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 2 inches. The Contracting Officer shall be notified of any contaminated materials.

#### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic.

#### 2.1.4 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 25 when tested in accordance with ASTM D 4318.

#### 2.1.5 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material shall be a uniformly graded washed sand with a maximum particle size of 1/2 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

#### 2.1.6 Impervious Fill

Impervious fill shall be satisfactory material classified in ASTM D 2487 as CL or CH, with liquid limit greater than 30 and plasticity index greater than 15.

### 2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and no more than 2 percent by weight shall pass the No. 4 size sieve.

## PART 3 EXECUTION

### 3.1 CLEARING AND GRUBBING

The areas within lines 5 feet outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be

completely removed and the resulting depressions shall be filled with satisfactory material, placed and compacted in accordance with paragraph FILLING AND BACKFILLING. Materials removed shall be disposed of outside the limits of Government-controlled property at the Contractor's responsibility.

### 3.2 TOPSOIL

Topsoil shall be stripped to a depth of 4 inches below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

### 3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified, and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the building line of each building and structure, excavation for all work incidental thereof. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms.

Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material; and payment will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced, at no additional cost to the Government, with satisfactory materials to the indicated excavation grade; except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

### 3.4 DRAINAGE AND DEWATERING

#### 3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

#### 3.4.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet below the working level.

### 3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as

necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

### 3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

### 3.7 BLASTING

Blasting will not be permitted.

### 3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

### 3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained as specified in Section 02300 EARTHWORK.

### 3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Section 02300 EARTHWORK.

### 3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond.

### 3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily

facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.13 FILLING AND BACKFILLING

3.13.1 General Filling and Backfilling

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
	-----	-----
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
Nonfrost susceptible materials		95
<u>Subgrade</u>		
Under building slabs, steps, and paved areas, top 12 inches	90	95
Under sidewalks, top 6 inches	85	90

Approved compacted subgrades that are disturbed by the Contractor's

operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompression over underground utilities and heating lines shall be by hand tamping.

### 3.13.2 Magazine Backfilling

After the concrete arches have been waterproofed and the concrete walls have been dampproofed as specified, arch cover fill materials shall be carefully placed to avoid damage to the waterproofing and dampproofing, and the sequence and method of placing and compacting the fill shall be such as not to distort the shape, alignment, and dimensions of the arches as shown.

Filling over a line of multiple arches shall not be started until all arches in the line have been waterproofed and dampproofed. Fill shall be brought up evenly and simultaneously on both sides of the arch. Filling operations shall commence at the front and rear of a structure and continue uniformly to the center. At no time shall heavy equipment be run over the fill directly above the arches. Distortion or damage to the arches or other work, as determined by the contracting Officer, shall be repaired or replaced by the Contractor at no additional cost to the Government.

### 3.14 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

#### 3.14.1 In-Place Densities

In-place density and moisture content test results shall be included with the Contractor's daily construction quality control reports.

##### 3.14.1.1 In-Place Density of Subgrades

One test per 500 square foot or fraction thereof.

##### 3.14.1.2 In-Place Density of Fills and Backfills

One test per 250 square foot or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 6 feet in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 250 square feet, or one test for each 50 linear foot of long narrow fills 100 feet or more in length. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows: One check per lift for each 250 linear feet of long narrow fills, and a minimum of 3 checks per lift for other fill and backfill areas.

##### 3.14.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

### 3.14.3 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material, including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

### 3.15 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

### 3.16 GRADING

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.17 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

### 3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

## SECTION 02316

## EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

## 1.2 NOT USED

## 1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Density Tests; GA. Testing of Backfill Materials; GA.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

## PART 2 PRODUCTS

## 2.1 MATERIALS

### 2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SM, SW-SM, and SP-SM.

### 2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

### 2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements shall not be considered as rock.

### 2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

### 2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

### 2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be 1 1/2 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

### 2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 2 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 1 inches in any dimension or as recommended by the pipe manufacturer, whichever is

smaller.

## 2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

## PART 3 EXECUTION

### 3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

#### 3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made no steeper than 2:1. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls more than 6 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

#### 3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

#### 3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

#### 3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

#### 3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

#### 3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

#### 3.1.2 Stockpiles

Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

#### 3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be

placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

### 3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

#### 3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

#### 3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

#### 3.2.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

#### 3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

### 3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 NOT USED

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 4 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 50 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The

calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

#### 3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

## SECTION 02510

## WATER DISTRIBUTION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM C 76	(1995a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM D 1599	(1988; R 1995) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996a) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1996) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D 2997 (1995) Centrifugally Cast "Fiberglass"  
(Glass-Fiber-Reinforced-Thermosetting-Resin)  
Pipe

ASTM D 3139 (1996a) Joints for Plastic Pressure Pipes  
Using Flexible Elastomeric Seals

ASTM D 3839 (1994a) Underground Installation of  
"Fiberglass" (Glass-Fiber-Reinforced  
Thermosetting Resin) Pipe

ASTM F 477 (1995) Elastomeric Seals (Gaskets) for  
Joining Plastic Pipe

ASTM F 1483 (1993) Oriented Poly(Vinyl Chloride),  
PVC0, Pressure Pipe

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1 (1983; R 1992) Pipe Threads, General  
Purpose (Inch)

ASME B16.1 (1989) Cast Iron Pipe Flanges and Flanged  
Fittings

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA ANSI/AWWA C104/A21.4 (1995) Cement-Mortar Lining for  
Ductile-Iron Pipe and Fittings for Water

AWWA ANSI/AWWA C105/A21.5 (1993) Polyethylene Encasement for  
Ductile-Iron Pipe Systems

AWWA ANSI/AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron  
Fittings, 3 In. Through 48 In. (75# mm  
through 1200# mm), for Water and Other  
Liquids

AWWA ANSI/AWWA C111/A21.11 (1995) Rubber-Gasket Joints for  
Ductile-Iron Pressure Pipe and Fittings

AWWA ANSI/AWWA C115/A21.15 (1994) Flanged Ductile-Iron Pipe With  
Ductile-Iron or Gray-Iron Threaded Flanges

AWWA ANSI/AWWA C151/A21.51 (1996) Ductile-Iron Pipe, Centrifugally  
Cast, for Water or Other Liquids

AWWA ANSI/AWWA C153/A21.53 (1994; Errata Nov 1996) Ductile-Iron  
Compact Fittings, 3 In. Through 24 In. (76  
mm through 610 mm) and 54 In. through 64  
In. (1,400 mm through 1,600 mm) for Water  
Service Liquids

AWWA C200 (1991) Steel Water Pipe - 6 In. (150 mm)  
and Larger

AWWA C500 (1993; C500a) Metal-Sealed Gate Valves for  
Water Supply Service

AWWA ANSI/AWWA C502 (1994; C502a) Dry-Barrel Fire Hydrants

AWWA C504 (1994) Rubber-Seated Butterfly Valves  
AWWA C509 (1994) Resilient-Seated Gate Valves for Water Supply Service  
AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances  
AWWA C606 (1987) Grooved and Shouldered Joints  
AWWA C800 (1989) Underground Service Line Valves and Fittings  
AWWA C900 (1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution  
AWWA C901 (1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service  
AWWA C905 (1988) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.  
AWWA C950 (1995) Fiberglass Pressure Pipe  
AWWA M23 (1980) Manual: PVC Pipe - Design and Installation

## ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA-01 (1988) Recommended Work Practices for A/C Pipe

## DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01 (1997) Thrust Restraint Design for Ductile Iron Pipe

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24 (1995) Installation of Private Fire Service Mains and Their Appurtenances  
NFPA 49 (1994) Hazardous Chemicals Data  
NFPA 325-1 (1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids  
NFPA 704 (1996) Identification of the Fire Hazards of Materials for Emergency Response

## NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 14 (1996) Plastics Piping Components and Related Materials  
NSF ANSI/NSF 61 (1997a) Drinking Water System Components -

## Health Effects (Sections 1-9)

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

## 1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

## 1.2.1 Service Lines

Piping for water service lines less than 3 inches in diameter shall be polyvinyl chloride (PVC) plastic, Oriented PVC plastic, or polyethylene, unless otherwise shown or specified.

## 1.2.2 Distribution Lines 80 mm (3 Inches) or Larger

Piping for water distribution lines 3 inches or larger shall be ductile iron, polyvinyl chloride (PVC) through 36 inch nominal diameter plastic, Oriented PVC plastic filament-wound or centrifugally cast reinforced thermosetting resin or reinforced plastic mortar pressure pipe, unless otherwise shown or specified.

## 1.2.3 NOT USED

## 1.2.4 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5 foot line.

## 1.2.5 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF ANSI/NSF 61.

## 1.2.6 Plastic Piping System

Plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF ANSI/NSF 14 and be legibly marked with their symbol.

## 1.2.7 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

## 1.3 NOT USED

## 1.4 NOT USED

## 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

SD-08 Statements

Waste Water Disposal Method; GA.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacteriological Disinfection; GA.

Test results from commercial laboratory verifying disinfection.

SD-13 Certificates

Manufacturer's Representative; FIO.

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified in all phases of PE, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers, prior to commencing installation.

Installation; FIO.

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

1.6 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark

place.

1.6.1 NOT USED

1.6.2 Polyethylene (PE) Pipe Fittings and Accessories

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

1.6.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 NOT USED

2.1.2 Plastic Pipe

2.1.2.1 PE Plastic Pipe

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.2.2 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4 inch Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure psi	Minimum Hydrostatic Pressure psi
26	100	133
21	120	160
17	150	200
13.5	200	266

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic

test pressure.

- b. Pipe 4 through 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.
- c. Pipe 14 through 36 inch Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

#### 2.1.2.3 Oriented Polyvinyl Chloride (PVCO) Plastic Pipe

Pipe, couplings, and fittings shall be manufactured of material conforming to ASTM D 1784, Class 1245B. Pipe shall conform to AWWA C900, Class 150, and to ASTM F 1483 and shall have an outside diameter equal to cast iron outside diameter.

#### 2.1.3 Reinforced Plastic Mortar Pressure (RPMP) Pipe

AWWA C950.

#### 2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

##### 2.1.4.1 RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

##### 2.1.4.2 RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

#### 2.1.5 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA ANSI/AWWA C151/A21.51, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA ANSI/AWWA C104/A21.4. Linings shall be standard. When installed underground, pipe shall be encased with 4 mil thick polyethylene in accordance with AWWA ANSI/AWWA C105/A21.5. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA ANSI/AWWA C115/A21.15.

## 2.2 FITTINGS AND SPECIALS

### 2.2.1 NOT USED

### 2.2.2 PVC Pipe System

- a. For pipe less than 4 inch diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings; fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA ANSI/AWWA C110/A21.10 or AWWA ANSI/AWWA C111/A21.11. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4.

- b. For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA ANSI/AWWA C110/A21.10, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA ANSI/AWWA C153/A21.53.

#### 2.2.3 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA ANSI/AWWA C104/A21.4 and shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11. Fittings shall be suitable for working and testing pressures specified for the pipe.

#### 2.2.4 Ductile-Iron Pipe System

Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA ANSI/AWWA C110/A21.10. Fittings and specials for use with push-on joint pipe shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4. Ductile iron compact fittings shall conform to AWWA ANSI/AWWA C153/A21.53.

### 2.3 JOINTS

#### 2.3.1 NOT USED

#### 2.3.2 Plastic Pipe Jointing

##### 2.3.2.1 PE Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation, and as approved by the Contracting Officer.

##### 2.3.2.2 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

##### 2.3.2.3 PVC0 Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

##### 2.3.3 RPMP Pipe

Joints shall be mechanical or bell and spigot type with elastomeric gasket.

##### 2.3.4 RTRP Pipe

###### 2.3.4.1 RTRP-I, Grade 1 and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

#### 2.3.4.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

#### 2.3.5 Ductile-Iron Pipe Jointing

- a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA ANSI/AWWA C111/A21.11.
- b. Push-on joints shall conform to AWWA ANSI/AWWA C111/A21.11.
- c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA ANSI/AWWA C111/A21.11.

#### 2.3.6 NOT USED

#### 2.3.7 NOT USED

#### 2.3.8 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

- a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.
- b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

#### 2.4 VALVES

##### 2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

- a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

- b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

#### 2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

- a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.
- b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.
- c. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

#### 2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

#### 2.4.4 NOT USED

#### 2.4.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

#### 2.4.6 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post.

#### 2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

## 2.6 NOT USED

## 2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA ANSI/AWWA C502 and UL approved with valve opening at least 5 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade. Hydrants shall have a 6 inch bell connection, two 2-1/2 inch hose connections and one 4-1/2 inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for each outlet, with caps, shall be furnished.

## 2.8 NOT USED

## 2.9 MISCELLANEOUS ITEMS

## 2.9.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

## 2.9.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

## 2.9.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

## 2.9.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

## 2.9.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating

collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

#### 2.9.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

#### 2.9.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

##### 3.1.2 Adjacent Facilities

###### 3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

###### 3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

###### 3.1.2.3 NOT USED

###### 3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

### 3.1.2.5 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be steel, manufactured in accordance with AWWA C200, ASTM A 36/A 36M, or reinforced concrete in accordance with and ASTM C 76, Class V as specified for storm drains in Section 02720 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve.

### 3.1.2.6 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

### 3.1.3 Joint Deflection

#### 3.1.3.1 NOT USED

#### 3.1.3.2 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

#### 3.1.3.3 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

### 3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

#### 3.1.4.1 NOT USED

#### 3.1.4.2 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be

installed in accordance with AWWA M23.

#### 3.1.4.3 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA-01.

#### 3.1.4.4 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

#### 3.1.4.5 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

#### 3.1.5 Jointing

##### 3.1.5.1 NOT USED

##### 3.1.5.2 PE Pipe Requirements

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

##### 3.1.5.3 PVC Plastic Pipe Requirements

- a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.
- b. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

##### 3.1.5.4 RTRP I, RTRP II and RPMP Pipe

- a. RTRP I: Assembly of the pipe shall be done in conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously.

However, the pipe shall not be moved and additional joints shall not be made until the previously laid joints are completely cured.

Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 1,500 psior greater when carried out in accordance with ASTM D 1599. At any ambient temperature, field bonded epoxy-cemented joints shall be cured with a self-regulating, thermostatically temperature controlled, electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating, or until the joint has cooled to ambient temperature.

- b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.
- c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 1/8 inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 100 foot pounds. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

#### 3.1.5.5 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

#### 3.1.5.6 NOT USED

#### 3.1.5.7 NOT USED

#### 3.1.5.8 NOT USED

#### 3.1.5.9 Bonded Joints Requirements

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

#### 3.1.5.10 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance

with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.11 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

- a. Service lines 1-1/2 inches and smaller shall have a service stop.
- b. Service lines 2 inches in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

### 3.1.6.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

### 3.1.7 NOT USED

### 3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

#### 3.1.8.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inches square. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

#### 3.1.8.2 NOT USED

#### 3.1.8.3 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

#### 3.1.8.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

### 3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

### 3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent

movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

#### 3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

#### 3.1.10.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

### 3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

#### 3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the project.

Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

#### 3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at

least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

### 3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

### 3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently if the specified requirements for both tests are strictly followed.
- b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

## 3.3 DISINFECTION

### 3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as specified. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid

state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

### 3.3.2 Lead Residual

Following the bacteriological disinfection and testing, the system shall be flushed with a sufficient velocity of water and sufficient tests performed at each hot and cold water discharge point until no more than 15 ppb lead residuals remain in the system. All tests and samples shall be performed in accordance with state and, if applicable, Federal regulations. Samples for testing are to be collected after a 6 hour continuous period of no flushing, and will be considered first draw samples. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. Lead residual test results shall be submitted to the Contracting Officer. The system will not be accepted until satisfactory bacteriological results and lead residual test results have been obtained. All flushing and testing for lead residuals, including all costs, are the responsibility of the Contractor.

### 3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

## SECTION 02521

## WATER WELLS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 150	(1997) Portland Cement
ASTM D 2239	(1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA A100	(1990) Water Wells
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C206	(1991) Field Welding of Steel Water Pipe

## CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 141	National Primary Drinking Water Regulations
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## 1.2 NOT USED

## 1.3 GENERAL REQUIREMENTS

The well shall be located as shown on the contract drawings. The well shall be of sufficient depth to penetrate a desirable water-bearing stratum and produce a continuous yield of 70 gpm of potable water. Potable is defined as water that is suitable for public consumption, i.e., water free from objectionable amounts of harmful bacteria, chemical, and physical substances as established by 40 CFR 141.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Water Well; GA.

Detail drawings illustrating materials to be used for the well installation shall be provided. Drawings shall show proposed layouts of the casing and screen in relation to the other materials of construction.

#### SD-08 Statements

Work Plan; GA.

Proposed plan for drilling test holes and constructing production wells, before beginning work. The plan shall include, but shall not be limited to, the proposed method of drilling and equipment to be used, details on proposed casing, well screen, grouting material, gravel pack material and method for placing gravel pack where required, and methods and equipment proposed for developing the well and for performing pump tests. Work shall not be performed until the drilling plan has been approved and deviation from the approved drilling plan will not be permitted without approval of the Contracting Officer. Details of specific methods to be employed to control potential contamination or pollution arising from well installation activities, shall also be included.

#### SD-09 Reports

Tests; GA.

Test Reports within 24 hours following the conclusion of each test.

#### SD-18 Records

Permits; FIO.

A copy of all permits, licenses, or other legal requirements necessary for execution of the work shall be obtained prior to commencement of field activities. Before beginning work, the local United States Geological Survey office (USGS) and the New Jersey Department of Environmental Protection (NJDEP), Bureau of Water Allocation shall be notified of the type and location of wells to be constructed, the method of construction, water quality testing, and anticipated schedule for construction of the wells. A copy of all such correspondence shall be furnished.

All equipment required to establish "potable water" in accordance with New Jersey Safe Drinking Water Act shall be contractor provided.

Boring Log; FIO.

An accurate log maintained during the drilling of the test hole. As a minimum, the log shall include depths, elevations, and descriptions of all formations encountered; identification of each stratum according to ASTM D 2487 ; or standard rock nomenclature, as necessary; and depths at which groundwater is encountered. Soil samples shall be taken each 10 feet with a split-spoon sampler. The Contractor shall prepare a graphic boring log to scale showing the required details. Five prints of the boring log drawing shall be submitted. This drawing shall be used for determining the well design, design of the gravel filter, well screen location and screen openings, and New Jersey permit requirements.

### 1.5 ENVIRONMENTAL PROTECTION

The Contractor shall take necessary precautions to prevent contaminated water, or water having undesirable physical or chemical characteristics, from entering the water supply stratum through the well bore or by seepage from the ground surface; and shall prevent contamination of the ground surface or of surface waters resulting from drilling of the test-hole or well.

## 1.6 TEST HOLES AND OBSERVATION WELLS

### 1.6.1 Test Holes

Before starting construction of the well, a test hole of at least 4 inches in diameter shall be drilled at the location of the well into the target water bearing stratum. The test hole shall be used to determine the expected yield from the well, water quality, optimum depth, and to log the strata encountered. A temporary casing shall be used. If used, the temporary casing shall be seated at the top of the stratum being tested. The test hole may be converted to the permanent well. If the test hole is not used for the permanent well, the test hole shall be filled with sand-cement grout placed by tremie or pumped through the drill pipe.

## 1.7 ABANDONMENT OF WELLS

If the Contractor fails to construct a well of the required capacity, or if the well is abandoned because of loss of tools or for any other cause, the Contractor shall fill the abandoned hole with sand-cement grout and remove the casing.

## PART 2 PRODUCTS

### 2.1 CASING

The casing shall be of sufficient size for the specified maximum yield. All casing, screen, and other well material shall be of compatible materials to prevent galvanic reaction between components of the completed well.

#### 2.1.1 Steel Casing and Couplings

Steel casing shall be standard weight galvanized steel pipe, conforming to ASTM A 53, as applicable. Joints shall be either threaded and coupled, or field welded in accordance with AWWA C206.

#### 2.1.2 NOT USED

#### 2.1.3 Inner Casing

The inner casing shall be sized at a minimum of 6 inches, based on the pump required in paragraph PERMANENT PUMP for maximum required yield, and shall be constructed of the same materials as the outer casing and the well screen. The inner casing shall be connected directly to the top of the well screen by an approved method.

### 2.2 WELL SCREENS

Well Screens shall be a minimum of 6 inches nominal diameter, and shall be directly connected to the bottom of the inner casing by an approved method.

The length of the screen shall be sufficient to provide an intake area capable of passing not less than the minimum required yield of the well, at an entrance velocity not exceeding 0.1 fps. The opening size shall be compatible with the material surrounding the screen and shall be submitted for approval as part of the drilling plan. The well screen shall be of sufficient size and design to hold back and support the gravel used in the gravel envelope and in-situ material surrounding the screen. The screen and all accessories required for satisfactory operation shall be essentially standard products of manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable.

#### 2.2.1 Metal Screen

Metal screen shall be of an approved wire-wound type with wire not less than No. 7 AWG and the supporting bars not less than 1/4 inch thickness.

Both wire and supporting bars shall be type 304 or type 314 stainless steel, conforming to the applicable requirements of AWWA A100. If a pipe core is used, it shall be at least schedule 10 pipe and shall be of the same material as the wire. A wire-wound screen manufactured with supporting bars or core of material different from the wire will not be acceptable. Joints shall be made of threaded couplings of the same material as the screens or by brazing or welding in accordance with AWWA C206.

### 2.3 GRAVEL PACK

Gravel pack shall be a product of a commercial sand and gravel manufacturer, shall be properly sized and graded for the surrounding soil and water encountered, and shall be composed of round, hard, waterworn siliceous gravel, free of flat or elongated pieces, organic matter, or other foreign matter. The gravel shall be of a size which will allow the maximum flow of water into the well and prevent the infiltration of sand and silt. The gradation of the filter gravel shall be such that the uniformity coefficient is not more than 2.5. The gravel shall be thoroughly sterilized with chlorine or hypochlorite immediately before being placed.

### 2.4 CEMENT GROUT

Cement grout shall consist of portland cement conforming to ASTM C 150, Type I or II, sand and water. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

### 2.5 PERMANENT PUMP

Permanent pump shall be an approved submersible type with a capacity sufficient to deliver 70 gpm at 65 psi, Section 11213 PERMANENT PUMP. The pump shall be connected to the pump controls by a three-wire drop line. Piping for the well drop line shall be polyethylene plastic pipe conforming to ASTM D 2239. The pump shall operate on 208 volts, 60 Hz, 3-phase power, and the motor shall be of sufficient size to operate the pump under the maximum operating conditions without exceeding its rating. Pump shall be equipped with necessary controls to provide for automatic operation of the pump. The pump and motor unit shall be no larger than 6 inches in diameter at any point.

## PART 3 EXECUTION

### 3.1 WELL CONSTRUCTION

The method of drill shall be as approved by the Contracting Officer and shall conform to all state and local standards for water well construction.

The execution of the work shall be by competent workmen and shall be performed under the direct supervision of an experienced well driller, licensed in the State of New Jersey. Casing pipe, well screens, and joint couplings shall be of compatible materials throughout each well. The well shall be a gravel pack well activated in the water-bearing stratum based on test hole data. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be initially drilled from the ground surface to the water bearing strata.

#### 3.1.1 NOT USED

#### 3.1.2 Construction of Inner Casing and Screen

The casing shall not be less than 6 inches in diameter. The borehole shall be of sufficient size to leave a concentric annular space of not less than 2 1/2 inches between the outside of the casing and the walls of the

borehole. The well screen and inner casing shall be lowered into the hole by a method which will allow for control of the rate of fall of the well screen and inner casing at all times. Well screen and inner casing shall not be dropped or allowed to fall uncontrolled into the hole. The inner casing shall extend up to the ground surface. Approved centering devices shall be installed at a spacing of 120 degrees between the casing and the walls of the borehole prior to well construction at intervals not exceeding 50 feet along the length.

### 3.1.3 Construction of Gravel Pack

After the screen and inner casing have been concentrically set in the hole, the approved gravel pack shall be constructed around the screen by filling the entire space between the screen and the wall of the hole in the water bearing stratum with filter gravel. Well screen and casing used for gravel pack wells shall have approved centering devices spaced 120 degrees apart at intervals not exceeding 50 feet along the length of the screen and inner casing. The gravel pack shall be tremied to the screened interval with conductor pipe. Gravel conductor pipe having an inside nominal diameter of not less than 1-1/2 inches shall be lowered to the bottom of the well between the hole and screen. Gravel conductor pipe shall be arranged and connected, at the surface of the ground, to water pumping and graveling equipment so that water and gravel, fed at uniform rates, are discharged as the gravel fills the hole from the bottom up. The gravel and water conductor shall be raised at a rate that will keep the bottom of the pipe between 1 and 3 feet under the gravel level at all times. If the Contractor desires to use methods of placing gravel other than those specified, the details of the method and equipment proposed shall be submitted to the Contracting Officer, before gravel placing is begun; however, dumping filter gravel from the surface of the ground and agitating the well in an effort to settle the filter will not be allowed. The gravel pack shall be installed continuously and without interruption until the gravel has been placed to a maximum of 10 feet above the top of the screen.

### 3.1.4 Placing Packer

After the casing, well screen and gravel pack have been installed, the annular space between the casings and the borehole shall be sealed by use of an approved packer. A cement/bentonite grout shall be used to seal the well. Grout conductor pipe having an inside diameter of not less than 1-1/2 inches shall be lowered to within 5 feet of the gravel pack. The grout conductor shall be raised at a rate that will keep the bottom of the pipe between 1 and 3 feet under the grout level at all times. The cement/bentonite grout shall extend from the top of the gravel pack to within 5 feet of the ground surface.

## 3.2 WELL DEVELOPMENT

The well shall be allowed to set no less than 24 hours after construction then developed in accordance with the drilling plan, by approved methods until the water pumped from the well is substantially free from sand and silt and until the turbidity is less than 5 on the Jackson Turbidity Scale specified in AWWA-01. Developing equipment shall be of an approved type and of sufficient capacity to remove all cutting fluids, sand, rock cuttings, and any other foreign material. The well shall be thoroughly cleaned from top to bottom before beginning the well tests.

## 3.3 TESTS

During construction of the well, when sufficient water is found to indicate that a well of required capacity may be developed, or when directed, a capacity test shall be performed. If the capacity test indicates that the required capacity can be obtained, the tests for quality of water shall be made. If the capacity and quality tests indicate that the required capacity and quality can be obtained, the permanent well, as specified,

shall be completed at that depth. Prior to making quality tests, drilling equipment, tools and pumps contacting well water shall be cleaned with live steam.

### 3.3.1 Capacity Test

The Contractor shall furnish and install an approved temporary test pump, with discharge piping of sufficient size and length to conduct the water being pumped to point of discharge, and equipment necessary for measuring the rate of flow and water level in the well. A continuous 8 hour capacity test shall be run with the pumping rate and drawdown at the pump well recorded every 1/2 minute during the first 5 minutes after starting the pump; then every 5 minutes for an hour; then every 20 minutes for 2 hours. From this point on, readings taken at hourly intervals shall be sufficient.

The test shall begin at the rate of the expected capacity of well and at least that rate maintained throughout the duration of the test. If this capacity cannot be maintained for the test period, the capacity test shall be terminated and the test hole drilled deeper or relocated as directed. The record of the test, in triplicate, shall be delivered to the Contracting Officer, in accordance with NJDEP, Bureau of Water Allocation Well record form. The well record form includes well permit number, well owner, name and address, well location address, well use, date construction, well construction details, pumping test records, permanent pumping equipment, geologic log, and certification by well driller.

### 3.3.2 Test for Plumbness and Alignment

Upon completion of the permanent well, plumbness and alignment shall be tested by lowering into the well, to the total depth of the well, a plumb 40 feet long or a dummy of the same length. The outer diameter of the plumb shall not be more than 1/2 inch smaller than the diameter of that part of the hole being tested. If a dummy is used, it shall consist of a rigid spindle with three rings, each ring being 2 inches wide. The rings shall be cylindrical and shall be spaced one at each end of the dummy and one in the center. The central member of the dummy shall be rigid so that it will maintain the alignment of the axis of the rings. If the plumb or dummy fail to move freely throughout the length of the casing or well screen for the depth of well or should the well vary from the vertical in excess of two-thirds the inside diameter of that part of the well being tested for each 100 feet of depth, the plumbness and alignment of the well shall be corrected by the Contractor. If the faulty alignment and plumbness is not correctable, as determined by the Contracting Officer, the well shall be abandoned as specified in paragraph ABANDONMENT OF WELLS and a new well drilled at no additional cost to the Government.

### 3.3.3 Test for Quality of Water

When the capacity test in the test hole has been completed, and again after the yield in the permanent well and drawdown test or capacity test have been completed, the Contractor shall secure samples of the water in suitable containers, and of sufficient quantity, to have bacterial, physical, and chemical analyses made by a recognized testing laboratory, except that the bacterial analysis may be made by the New Jersey State Board of Health, if desired. Water Quality Analysis shall address each item specified in the Water Quality Analysis Table at the end of this section. Expenses incident to these analyses shall be borne by the Contractor and the results of the analyses shall be furnished to the Contracting Officer. All sampling and analyses shall be performed using EPA and NJDEP approved methods, procedures, and holding times.

### 3.3.4 Aquifer Test

Following completion of the permanent water well and submersible pump, an 8-hour step-draw down test shall be conducted to evaluate the aquifer yield. The step-drawdown test involves increasing pumpage from the well in

successive equal steps or stages. The well shall be pumped at a minimum of four different rates: 25, 50, 75, and 100 percent of the well capacity identified in 3.3.1. The pumping rate for each step shall be held constant and maintained for a minimum of two hours. If the highest pumping rate cannot be achieved, then a rate as high as possible shall be used. Drawdown at the pump well shall be recorded every 1/2 minute during the first 5 minutes after starting the pump; then every 5 minutes for an hour; every 20 minutes for 2 hours; then every 30 minutes for the remainder of the test.

3.4 INSTALLATION OF PERMANENT PUMP

The permanent well pump shall be installed in accordance with Section 02523 SUBMERSIBLE PUMP INSTALLATION, in the well at a minimum depth of 25 feet below the maximum drawdown groundwater level after the drawdown test has been completed. The pump shall be secured at the required elevation as recommended by the pump manufacturer.

3.5 DISINFECTING

After completion of tests of well, or installation of permanent pump, or at time of tests for yield and drawdown test, whichever is later, the wells shall be disinfected by adding chlorine, conforming to AWWA B301, or hypochlorite, conforming to AWWA B300, in sufficient quantity so that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and introduced into the well in an approved manner and shall remain in the well for period of at least 24 hours. Disinfection of well shall be in accordance with any method described in Sections A1 thru A10 of AWWA A100. After the contact period, the well shall be pumped until the residual chlorine content is not greater than 1.0 ppm. The well shall be disinfected and redisinfecting as may be required until two consecutive samples of water are found upon test to be free from Coli Acrogenes group of organisms.

3.6 CONCRETE VAULT

The concrete vault shall be constructed to prevent infiltration of surface water or precipitation into the well. The vault shall be 4 feet square by 4 feet deep and constructed of reinforced concrete. The top of the outer casing shall extend 18 inches above the base of the vault. The base of the slab will be 4 feet below the ground surface. The concrete vault shall be installed in accordance with Section 02571 PRECAST CONCRETE VAULT.

3.7 CLEAN-UP

Upon completion of the well construction and other incidentals, all debris and surplus materials resulting from the work shall be removed from the jobsite.

WATER QUALITY ANALYSIS TABLE

Physical Characteristics

Color	Resistivity in ohms per cubic
Taste	centimeter and 25 degrees C.
Threshold odor number	pH value
Turbidity	Temperature

Chemical Characteristics (Expressed as mg/L)

Arsenic	Total Hardness as CaCO(3)
Barium	VOC (Volatile Organic Compounds)

Chemical Characteristics (Expressed as mg/L)

Cadmium	SOC (Synthetic Organic Compounds)
Chromium	Total Organic Halogens (TOX)
Copper	TOC (Total Organic Carbon)
Lead	Sulphates as SO(4)
Mercury	Chlorides as Cl
Selenium	Bicarbonates as HCO(3)
Silver	Carbonates as CO(3)
Zinc	Nitrates as NO(3)
Fluoride as F	Alkalinity (methyl-orange)
Manganese as Mn (dissolved and total)	(Phenolphthalein) as CaCO(3)
Iron as Fe (dissolved and total)	Silica as SiO(2)
Suspended Solids	Radionuclides
Total Dissolved Solids	
Calcium as Ca	
Magnesium as Mg	
Sodium and Potassium as Na	

-- End of Section --

## SECTION 02523

## SUBMERSIBLE PUMP INSTALLATION

## PART 1 GENERAL

## 1.1 SCOPE OF WORK

The submersible pump installation work will include furnishing and installing the pump, pre-cast concrete well vault with locking steel watertight door, and backfill materials as indicated on the Drawings and specified herein.

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Pump Installation Work Plan; GA.

Proposed plan for installing the concrete vault, well pump and associated piping materials shall be submitted, before beginning work. The plan shall include, but shall not be limited to, the proposed method and equipment to be used for the installation of the concrete vault, submersible pump and associated piping. Work shall not be performed until the pump installation work plan has been approved and deviation form the approved plan will not be permitted without approval of the Contracting Officer.

## 1.3 NOT USED

## 1.4 GENERAL REQUIREMENTS

The concrete vault and submersible pump shall be installed as shown on the Drawings. The concrete vault shall be installed to prevent surface water infiltration into the well pit. The pump shall be an approved submersible pump capable of delivering 70 gpm.

## 1.5 ENVIRONMENTAL PROTECTION

The Contractor shall take necessary precautions to prevent contaminated water, or water having undesirable physical or chemical characteristics, from entering the water supply stratum through the well or by seepage from the ground surface.

## 1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## PART 2 PRODUCTS

## 2.1 SELECT GRANULAR BACKFILL

Select granular backfill shall consist of durable, clean, washed, and graded gravel meeting the requirements of select granular material in Section 703.3 of PennDOT Publication 408.

## 2.2 GEOTEXTILE FILTER FABRIC

A woven, polypropylene geotextile shall be furnished and installed to separate the select backfill from the existing materials. Bias weave material shall be used. This material shall have the following minimum properties:

<u>Fabric Property</u>	<u>Minimum Property</u>
Composition	Polypropylene
Tensile Strength	275 lbs. at 11% Elongation
Apparent Opening Size	No. 70 Standard Sieve
Permeability	0.05 cm/sec

## 2.3 PUMP

The pump for the extraction wells shall be a Model 85S100-8 10-hp pump with Teflon seals as manufactured by Grundfos Pump Corporation, Clovis, California, or an approved equal. Pump requirements for the extraction wells are given in Section 11213 of these Specifications.

## 2.4 DOWNWELL PIPING

Piping shall be nominal two-inch diameter schedule 40, threaded joint, galvanized steel pipe. Threaded connections shall be sealed with PTFE pipe tape and sealed with pipe joint compound made from virgin Teflon.

## 2.5 PITLESS ADAPTER

A stainless steel pitless adapter shall be provided for the water supply well as shown in the Drawings. The adapter should be suited for 6-inch inside diameter well casing. The adapter shall consist of Midwest Adapters Model 6-J-2 welded 2-inch pitless adapter or approved equal.

## 2.6 CONCRETE VAULT

A pre-cast HS-20 traffic rated concrete vault shall have 4 feet by 4 feet by 4 feet inside dimensions, be equipped with a dual door with a HS-20 traffic load rated watertight, spring hinged, locking lid, as manufactured by the BILLO Door Company, or an approved equal. The vault will be constructed without a bottom, with concrete knockout panels on the sides, and in accordance with Section 02571.

## PART 3 EXECUTION

### 3.1 PROCEDURES

The water supply well system shall be constructed to the elevation, lines, grades, and cross sections shown on the Drawings and in accordance with these Specifications, unless otherwise directed by the Contracting Officer.

### 3.2 EXCAVATION

The Contractor shall excavate the well vault to a depth of 4-1/2 feet below ground surface. The depth of excavation shall be to allow for bedding and pipe installation below the frost line. The estimated depths of the well vault are shown on the Drawings. The actual depths of the well vault will be approved by the CLIENT'S representative. The Contractor shall be responsible for measuring and recording the depth of the excavation.

Material excavated from the excavation shall be placed on the spoil pile adjacent to the trench as specified in the approved Work Plan.

### 3.3 BACKFILLING

Backfilling for the concrete vault shall commence as soon as practical. The areas for storing gravel backfill material shall be in accordance with the approved Work Plan.

3.4 Disposal of Trench Excavated Material

The Contractor shall dispose of the excavated material in accordance with the approved Work Plan.

3.5 PUMP AND PIPING

Pump and piping, as shown on the Drawings, shall be installed in the well casing at the appropriate time.

-- End of Section --

## SECTION 02531

## SANITARY SEWERS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM C 425	(1996) Compression Joints for Vitriified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 564	(1995a) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(1996) Vitriified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1991, R 1996) Low-Pressure Air Test of Vitriified Clay Pipe Lines
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(1996) "Fiberglass" (Glass-Fiber-Reinforced

	Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3840	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

## UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl

Chloride (PVC) Profile Wall Gravity Sewer  
Pipe and Fittings Based on Controlled  
Inside Diameter (Nominal Pipe Sizes 4-48  
inch)

## 1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

## PART 2 PRODUCTS

### 2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

#### 2.1.1 NOT USED

#### 2.1.2 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 8 inch through 15 inch diameter.

##### 2.1.2.1 ABS Pipe

ASTM D 2751.

##### 2.1.2.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 15 inches or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8 inch through 48 inch diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

##### 2.1.2.3 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 18 inch through 120 inch. ASTM F 714, size 4 inch through 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills.

##### 2.1.3 Reinforced Plastic Mortar Pipe (RPMP)

ASTM D 3262.

#### 2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

ASTM D 3262.

##### 2.1.4.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

##### 2.1.4.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

#### 2.1.5 Ductile Iron Pipe

Pipe shall conform to AWWA ANSI/AWWA C151/A21.51 unless otherwise shown or specified.

#### 2.1.6 Cast Iron Soil Pipe

Cast iron soil pipe shall conform to ASTM A 74, Class SV, except where Class XH is indicated.

#### 2.1.7 Clay Pipe

ASTM C 700 Extra strength.

### 2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

#### 2.2.1 NOT USED

#### 2.2.2 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

##### 2.2.2.1 Fittings for ABS Pipe

ASTM D 2751.

##### 2.2.2.2 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

##### 2.2.2.3 Fittings for High Density Polyethylene Pipe

ASTM F 894.

##### 2.2.3 Fittings for RPMP

ASTM D 3840.

##### 2.2.4 Fittings for RTRP

ASTM D 3262.

#### 2.2.5 Fittings for Ductile Iron Pipe

Mechanical fittings shall conform to AWWA ANSI/AWWA C110/A21.10, rated for 150 psi. Push-on fittings shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11, rated for 150 psi.

#### 2.2.6 Fittings for Cast Iron Soil Pipe

ASTM A 74.

#### 2.2.7 Fittings for Clay Pipe

ASTM C 700 Extra strength.

### 2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

#### 2.3.1 NOT USED

#### 2.3.2 Plastic Pipe Jointing

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

##### 2.3.2.1 ABS Pipe Jointing

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 12 inches or less in diameter, dimensions and tolerances in accordance with Table 2 of ASTM D 2751.

##### 2.3.2.2 High Density Polyethylene Pipe Jointing

Rubber gasket joints shall conform to ASTM C 443.

#### 2.3.3 RPMP Jointing

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

#### 2.3.4 RTRP Jointing

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

#### 2.3.5 Ductile Iron Pipe Jointing

Push-on joints shall conform to AWWA ANSI/AWWA C111/A21.11. Mechanical joints shall conform to AWWA ANSI/AWWA C111/A21.11 as modified by AWWA ANSI/AWWA C151/A21.51. Flanged joints shall conform to AWWA ANSI/AWWA C115/A21.15.

#### 2.3.6 Cast Iron Soil Pipe Jointing

Rubber gaskets for compression joints shall conform to ASTM C 564. Packing material for caulked joints shall be twisted jute or oakum, tarred type, or asphalt-saturated cellulose-fiber. Joints for acid resisting cast iron soil pipe shall be made with acid resistant non-asbestos packing. The packing shall not contain material which would affect adhesion of the joint sealing material to the pipe. Lead shall be suitable for caulking of joints.

#### 2.3.7 Clay Pipe Jointing

Compression joints shall conform to ASTM C 425.

## 2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

## 2.8 STRUCTURES

### 2.8.1 Double-Wall Fiberglass Holding Tanks

Double-wall fiberglass tank, size and configuration as shown, complete with concrete pad, hold down straps, inlet adapters, manway and louver, with pedestal mounted alarm and controls. Size as indicated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Adjacent Facilities

##### 3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

##### 3.1.1.2 Roads, Railroads, and Airfields

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be as specified for storm drains in Section 02630 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with the corrosion protection as required for the conditions encountered at the site of installation.

##### 3.1.1.3 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

### 3.1.2 Pipe Laying

- a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.
- b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.
- c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
- d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.
- e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

#### 3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 1 inch after caulking.

#### 3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

#### 3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

#### 3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

#### 3.1.2.5 Jointing

Joints between different pipe materials shall be made as specified, using

approved jointing materials.

### 3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

### 3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 0.2 gal per inch diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

### 3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

### 3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 NOT USED

3.5 NOT USED

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

## SECTION 02571

PRE-CAST CONCRETE VAULT  
CONTRACTOR'S OPTION

## PART 1 GENERAL

## 1.1 SCOPE OF WORK

Without intending to limit and/or restrict the volume of work required by this section of the Specifications and the Drawings, the work consists of furnishing all labor, materials, equipment, transportation, services, and appliances necessary to complete the installation of the Pre-cast Concrete Vault, referred to in Section 02521 PERMANENT WATER WELL INSTALLATION. Provisions of the Contract Documents, including requirements of Division 1 of these Specifications, apply to all work of this section. The Contractor shall consult in detail the above-mentioned provisions before proceeding with the work.

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 36	Structural Steel
ASTM C 150	Portland Cement

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Pre-Cast Concrete Vault; FIO.

Detail drawings, fabricator's installation instructions, and product data under provisions of Contract Documents. Submit shop drawings indicating layout, fabrication details, reinforcement, connection details, support items, dimensions, and openings. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

## 1.4 QUALITY ASSURANCE

Materials, manufacturing procedures, and workmanship are subject to inspection and testing in the factory and field. Such inspections and tests are not to relieve the Contractor of responsibility for providing materials and installation procedures in compliance with specified requirements.

## 1.4.1 Remedial Action

The Contractor shall promptly remove and replace materials and workmanship found defective, and shall provide new acceptable work in accordance with Contract requirements.

#### 1.4.2 Coordination

The Contractor shall review installation procedures, and shall coordinate with adjacent work.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered at such intervals as will avoid delays in the work. Deliveries shall be coordinated by the Contractor. Handle pre-cast members in position consistent with their shape and design. Lift and support only from support points. Use lifting or handling devices capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection. Protect members to prevent staining, chipping, or spalling of concrete.

#### 1.6 JOB CONDITIONS

The Contractor shall examine the substrate and conditions under which the work is to be performed. Do not proceed with the work until unsatisfactory substrate conditions have been corrected.

### PART 2 PRODUCTS

#### 2.1 CEMENT

Cement grout shall consist of Portland cement conforming to ASTM C 150, Type I or III, sand and water. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that the well can be properly grouted. No more than 3 percent by weight of bentonite powder may be added to reduce shrinkage. Non shrink; minimum yield strength of 10,000 psi at 28 days.

#### 2.2 AGGREGATE, SAND, WATER, ADMIXTURES

Determined by pre-cast fabricator as appropriate to design requirements.

#### 2.3 CONNECTING AND SUPPORTING DEVICES

ASTM A 36 carbon steel plates, angles, items cast into concrete, or items connected to steel framing members, and inserts; hot-dip galvanized in accordance with ASTM A 153.

#### 2.4 DOORS

Provide HS20 rated dual doors, with spring leaf hinges, lock, and watertight seals as manufactured by the BILCO Door Company or approved equal. The door shall be cast into and an integral part of the vault structure. The doors shall be sized to withstand design loads in a restrained condition (vertical load) for a HS20 highway rating. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges. Design system to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings

### PART 3 EXECUTION

#### 3.1 FINISHING

Ensure exposed to view finish surfaces of pre-cast concrete members are

uniform in color and appearance. Normal plant finish with fins and protrusions removed, ground edges and ends, and flat face surfaces.

### 3.2 TOLERANCES

The Maximum Variation from Nominal Dimension will be no more than 1 inch.  
The Maximum Misalignment of Anchors, Inserts, Openings will be no more than 1/8 inch.

### 3.3 INSTALLATION

Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

-- End of Section --

## SECTION 02621

## FOUNDATION DRAINAGE SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 252	(1994) Corrugated Polyethylene Drainage Tubing
AASHTO M 294	(1994) Corrugated Polyethylene Pipe, 305- to 915-mm (12- to 36 in.) Diameter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM C 33	(1993) Concrete Aggregates
ASTM D 1117	Nonwoven Fabrics (Trapezoidal Tear Test)
ASTM D 1682	Breaking Load and Elongation of Textile Fabric
ASTM D 751	Test Coated Fabric
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 405	(1996) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 667	(1985) Large Diameter Corrugated Polyethylene Tubing and Fittings
ASTM F 758	(1993) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Materials; FIO.

Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 DELIVERY, STORAGE AND HANDLING

Materials placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Plastic pipe shall not be exposed to direct sunlight for more than 6 months from time of manufacturer to installation.

PART 2 PRODUCTS

2.1 MATERIALS

Pipe for foundation drainage system shall be of the type and size indicated. Appropriate transitions, adapters, or joint details shall be used where pipes of different types or materials are connected.

2.1.1 NOT USED

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 Cast-Iron Soil Pipe

ASTM A 74, extra-heavy.

2.1.10 NOT USED

2.1.11 NOT USED

2.1.12 NOT USED

2.1.13 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.13.1 Corrugated Polyethylene (PE) Drainage Pipe

The Contractor shall furnish ASTM F 405 heavy duty for pipe 3 to 6 inches in diameter inclusive, ASTM F 667 for pipe 8 to 24 inches in diameter; or AASHTO M 252 for pipe 3 to 10 inches in diameter or AASHTO M 294 for pipe 12 to 24 inches in diameter. Fittings shall be pipe manufacturer's standard type and shall conform to the indicated specification.

2.1.13.2 Acrylonitrile-Butadiene-Styrene (ABS) Pipe

ASTM D 2751, with a maximum SDR of 35.

#### 2.1.13.3 Polyvinyl Chloride (PVC) Pipe

ASTM F 758, Type PS 46, ASTM D 3034, or ASTM F 949 with a minimum pipe stiffness of 46 psi.

#### 2.1.13.4 Circular Perforations in Plastic Pipe

Circular holes shall be cleanly cut, not more than 5/16 inch or less than 3/16 inch in diameter, and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 3 inches apart, center-to-center, along rows. The rows shall be approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket and perforations shall continue at uniform spacing over the entire length of the pipe. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

#### 2.1.13.5 Slotted Perforations in Plastic Pipe

Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch or be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing; 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing; and 2-1/2 inches on 10 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe. The water inlet area shall be a minimum of 0.5 square inch per linear foot of tubing. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

#### 2.1.14 Fittings

Fittings shall be of compatible materials for pipe, of corresponding weight and quality, and as specified herein.

#### 2.1.15 Cleanouts and Piping Through Walls

Cleanout pipe and fittings and piping through walls and footings shall be cast-iron soil pipe. Each cleanout shall have a brass ferrule and a cast-brass screw-jointed plug with socket or raised head for wrench.

#### 2.1.16 NOT USED

#### 2.1.17 Bedding and Pervious Backfill for Foundation Drains

Bedding and pervious backfill shall be coarse aggregate conforming to ASTM C 33, size number 8.

#### 2.1.18 Protective Covering for Pervious Backfill

Protective covering shall be filter fabric as specified below.

### 2.2 DRAINAGE COMPOSITES

The drainage composite shall consist of a filter fabric and a drainage mat meeting the requirements specified below. The filter fabric and drainage mat may be separate materials or a composite of the two materials bonded

together during manufacture.

2.2.1 Filter Fabric

Filter fabric shall be non-woven pervious sheet of long chain polymeric filaments of polypropylene or polyester, formed by needle punching into a pattern with distinct and measurable openings. The filter fabric shall provide an equivalent opening size (EOS) no finer than the US Standard Sieve No. 120 and no coarser than the US Standard Sieve No. 70 EOS joined accordingly to the manufacturer's recommendations. The composite shall be laid smooth and free of tension, stress, wrinkles, folds, or creases. The drainage composite shall be placed in accordance with the manufacturer's recommendations. Care shall be taken during installation to prevent damage to the drainage composite, waterproofing, or the structure.

2.2.1.1 Contractor's Responsibility

Any drainage composite with defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, storage, handling, installation, or backfilling will be rejected by the Contracting Officer and will be replaced or repaired by the Contractor, as directed, at no additional cost to the Government.

2.2.2 Drainage Mat

The drainage mat shall be nylon, polyethylene or other high-strength plastic of adequate size to carry groundwater from the filter fabric to the drainage outlet and of adequate strength to prevent crushing during installation or by lateral earth pressures during in-service use. The mat configuration shall provide multi-directional water flow.

Table I. Physical Strength Requirements

<u>Physical Property</u>	<u>Test Procedure</u>	<u>Acceptable Test Results</u>
Tensile Strength (unaged fabric)*	ASTM D 1682, Grab Test Method using 1-inch square jaws and a travel rate of 12 inches per minute	215 pounds per inch minimum in any principle direction
Puncture Strength (unaged fabric)*	ASTM D 751, Tension Testing Machine with Ring Clamp; steel ball replaced with a 5/16-inch diameter solid steel cylinder with a flat tip centered within the ring clamp	90 pound minimum
Elongation at Failure (unaged fabric)*	ASTM D 1682	60 percent minimum
Trapezoidal Tear Strength (unaged fabric)*	ASTM D 1117	80 pounds minimum

\*UNAGED FABRIC IS DEFINED AS FABRIC IN THE CONDITION AS RECEIVED FROM THE MANUFACTURER OR DISTRIBUTOR.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 Extent

Foundation drainage shall be furnished and installed as a complete system as shown.

### 3.1.2 Outlet Connections

Foundation pipe shall be terminated as shown.

### 3.1.3 Drainage Lines

Drainage lines shall be constructed of perforated pipe.

### 3.1.4 Outlet Lines

Outlet lines shall be constructed of closed-joint nonperforated, nonporous pipe.

## 3.2 INSTALLATION

### 3.2.1 Trenching and Excavation

Required trenching and excavation shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Trenches shall be kept dry during installation of drainage system. Changes in direction of drain lines shall be made with 1/8 bends. Wye fittings shall be used at intersections.

### 3.2.2 Bedding

Graded bedding, minimum 6 inches in depth, shall be placed in the bottom of trench for its full width and length and compacted as specified prior to laying of foundation drain pipe. Each section shall rest firmly upon the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, the bedding shall fully support the lower quadrant of the pipe.

### 3.2.3 Pipe Laying

Drain lines shall be laid to true grades and alignment with a continuous fall in the direction of flow. Bells of pipe sections shall face upgrade. Interior of pipe shall be cleaned thoroughly before being laid. When drain lines are left open for connection to discharge lines, the open ends shall be temporarily closed and the location marked with wooden stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and relaid at no additional cost to the Government. Perforated corrugated polyethylene drainage tubing and plastic piping shall be installed in accordance with manufacturer's specifications and as specified herein. Tubing and piping with physical imperfections shall not be installed.

### 3.2.4 Jointing

#### 3.2.4.1 Perforated and Porous Pipes

Perforated drain pipes shall be laid with closed joints.

#### 3.2.4.2 Nonperforated Drain Tile

Nonperforated and plain-end drain tile shall be laid with 1/8 to 1/4 inch open joints. Open joints shall be covered or wrapped. Covered joints shall have one thickness of the cover material placed over the joint. Material shall overlap the joint not less than 4 inches on each side and cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. Strips of wire cloth wrapping material 3 inches wide shall be used for wrapped joints, with ends fastened

together.

3.2.4.3 NOT USED

3.2.4.4 NOT USED

3.2.4.5 Joints of Cast-Iron Pipe

Joints of cast-iron pipe or connections between cast-iron and porous concrete pipes shall be caulked with oakum gasket and filled with lead.

3.2.4.6 NOT USED

3.2.4.7 NOT USED

3.2.4.8 ABS Pipe

ABS pipe shall be joined using solvent cement or elastomeric joints and shall be in accordance with ASTM D 2751, with dimensions and tolerances in accordance with TABLE II therein.

3.2.4.9 PVC Pipe

PVC pipe joints shall be in accordance with ASTM D 3034, ASTM D 3212, or ASTM F 949.

3.2.4.10 Corrugated Polyethylene

Corrugated polyethylene (PE) pipe joints shall be in accordance with ASTM F 405 or ASTM F 667.

3.2.5 Outlet Lines

The outlet end of drain lines connecting with an open gutter or outfall shall be covered with a removable wire basket of 16-mesh copper or bronze wire cloth fastened with brass or wire straps.

3.2.6 Backfilling

After joints and connections have been inspected and approved, the specified pervious backfill material shall be placed a minimum width of 6 inches on each side of the pipe or tile for the full width of the trench and full width between pipe and adjacent walls and 12 inches above the top of the pipe. The backfill shall be placed preventing displacement of or injury to the pipe or tile. A protective covering, as specified, shall be placed over the pervious backfill for the full width of the trench before regular backfill is placed. Backfill shall be compacted as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.7 Cleanouts

Cleanouts shall be provided in locations indicated. Cleanouts in unpaved areas shall be set in 12 by 12 by 4 inch concrete blocks.

3.2.8 Drainage Composites

The drainage composite shall be rolled circumferentially across the structure with ends of the composite extended into the gravel filter material surrounding the footing drains. Circumferential seams shall be overlapped a minimum of 18 inches and joined according to the manufacturer's recommendations. Care shall be taken during installation to prevent damage to the drainage composite, waterproofing, or the structure.

-- End of Section --

SECTION 02630  
STORM-DRAINAGE SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges
AASHTO M 198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 294	(1994) Corrugated Polyethylene Pipe, 305- to 915- mm (12-to 36 in.) Diameter
AASHTO MP6	(1995) Corrugated Polyethylene Pipe 1050 and 1200 mm Diameter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 929/A 929M	(1996) Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B 26/B 26M	(1997) Aluminum-Alloy Sand Castings
ASTM C 139	(1997) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1997a) Mortar for Unit Masonry
ASTM C 425	(1997) Compression Joints for Vitriified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 789	(1995a) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and

## Sewers

ASTM C 850	(1995a) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 ft of Cover Subjected to Highway Loadings
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(1996) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Pipe and Drainage Structures; FIO.

Shop drawings and manufacturer's cut sheets of precast concrete endwalls, polyethylene pipe, catch basins, and grates.

## SD-06 Instructions

Placing Pipe; FIO.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

## SD-13 Certificates

Resin Certification; FIO. Hydrostatic Test on Watertight Joints; FIO. Determination of Density; FIO. Frame and Cover for Gratings; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

## 1.4 DELIVERY, STORAGE, AND HANDLING

## 1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

## 1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

## PART 2 PRODUCTS

## 2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 NOT USED

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.9.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.9.2 Corrugated PE Pipe

AASHTO M 294, Type S, for pipes 12 to 36 inches and AASHTO MP6, Type S or D, for pipes 42 to 48 inches produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 315412C or 324420C. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543

2.1.9.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
		Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.2 DRAINAGE STRUCTURES

### 2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

### 2.2.2 Precast Reinforced Concrete Box

For highway loadings with 2 feet of cover or more or subjected to dead load only, ASTM C 789; for less than 2 feet of cover subjected to highway loading, ASTM C 850.

## 2.3 MISCELLANEOUS MATERIALS

### 2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231.

The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

### 2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities.

The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

### 2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

### 2.3.4 NOT USED

### 2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

### 2.3.6 NOT USED

### 2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

## 2.3.8 Joints

### 2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete sections. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

### 2.3.8.2 NOT USED

### 2.3.8.3 NOT USED

### 2.3.8.4 NOT USED

### 2.3.8.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

### 2.3.8.6 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-16, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

### 2.3.8.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

## 2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

## 2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48, Class 30B or 35B. Shape and size shall be as indicated.

## 2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

### 2.6.1 PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Test requirements for joints in PE plastic pipe shall conform to ASTM D 3212.

## PART 3 EXECUTION

## 3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and Section 02300 EARTHWORK and the requirements specified below.

## 3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be adequate for satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

## 3.1.2 NOT USED

## 3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheet piling, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

## 3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

## 3.2.1 NOT USED

## 3.2.2 NOT USED

## 3.2.3 NOT USED

## 3.2.4 NOT USED

## 3.2.5 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

## 3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as

necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 NOT USED

3.3.2 NOT USED

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.4 NOT USED

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, precast reinforced concrete, complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in

place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

### 3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches.

### 3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

### 3.7.4 Compaction

#### 3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

#### 3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than that of the surrounding material.

#### 3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density

relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

-- End of Section --

## SECTION 02722

## GRADED-CRUSHED AGGREGATE BASE COURSE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 180 (1993) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M (1997) Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 88 (1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C 117 (1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 127 (1988; R 1993) Specific Gravity and Absorption of Course Aggregate

ASTM C 128 (1993) Specific Gravity and Absorption of Fine Aggregate

ASTM C 131 (1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM D 75 (1987; R 1992) Sampling Aggregates

ASTM D 422 (1963; R 1990) Particle-Size Analysis of Soils

ASTM D 1556 (1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 2167 (1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2487 (1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire Cloth Sieves for Testing Purposes

## 1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

### 1.2.1 NOT USED

### 1.2.2 Graded-crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

### 1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D.

## 1.3 NOT USED

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Plant, Equipment, and Tools; FIO.

List of proposed equipment to be used in performance of construction work, including descriptive data.

### SD-09 Reports

Sampling and testing; GA. Field Density Tests; GA.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

### SD-18 Records

## 1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

### 1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

#### 1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

##### 1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM D 422. Sieves shall conform to ASTM E 11.

##### 1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

##### 1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with AASHTO T 180, Method D.

##### 1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

##### 1.5.2.5 Wear Test

Wear tests shall be made on GCA course material in conformance with ASTM C 131.

##### 1.5.2.6 Soundness

Soundness tests shall be made on GCA in accordance with ASTM C 88.

#### 1.5.3 Testing Frequency

##### 1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index moisture-density relationship.

- c. Moisture-density relationship.
- d. Wear.

#### 1.5.3.2 In Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted GCA. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Sieve Analysis shall be performed for every 500 tons, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

#### 1.5.4 Approval of Material

The source of the material shall be selected 14 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted GCA.

#### 1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

#### 1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

### PART 2 PRODUCTS

#### 2.1 AGGREGATES

The GCA shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. GCA shall be free of silt and clay as defined by ASTM D 2487, organic matter, and other objectionable materials or coatings.

The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

##### 2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 65 pcf as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 NOT USED

2.1.1.2 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. GCA coarse aggregate shall not exhibit a loss greater than 50 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 NOT USED

2.1.2.2 Graded-Crushed Aggregate Base Course

GCA fine aggregate shall consist of angular particles produced by crushing stone, slag, recycled concrete, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the 1/2 inch sieve.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 1 1/2 inches and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 2
2 inch	----
1-1/2 inch	100
1 inch	60-100
1/2 inch	30-65
No. 4	20-50
No. 10	15-40
No. 40	5-25
No. 200	0-10

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the GCA is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

### 3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the GCA, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the GCA, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the GCA.

Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the GCA is placed.

### 3.5 INSTALLATION

#### 3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory GCA meeting all requirements of this specification.

#### 3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the GCA is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable GCA.

#### 3.5.3 Grade Control

The finished and completed GCA shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required GCA thickness so that the finished GCA with the subsequent surface course will meet the designated grades.

#### 3.5.4 Edges of Base Course

The GCA shall be placed so that the completed section will be a minimum of 5 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of GCA in sufficient quantities to compact to the thickness of the

course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of GCA. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

#### 3.5.5 Compaction

Each layer of the GCA shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory GCA. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

#### 3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 8 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the GCA course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the GCA course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

#### 3.5.7 NOT USED

#### 3.5.8 Finishing

The surface of the top layer of GCA shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of GCA is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

### 3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 100 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

### 3.6 TRAFFIC

Completed portions of the GCA course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

### 3.7 MAINTENANCE

The GCA shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any GCA that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of GCA that is damaged shall be reworked or replaced as necessary to comply with this specification.

### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

## SECTION 02731

## AGGREGATE SURFACE COURSE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3740	(1996) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation;

submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data.

SD-09 Reports

Sampling and Testing; GA. Density Test; GA.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Test results from samples, not less than 30 days before material is required for the work. Results of laboratory tests for quality control purposes, for approval, prior to using the material.

1.5 EQUIPMENT

All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

1.6 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by the Contractor, subject to approval. If the Contractor elects to establish its own testing facilities, approval of such facilities will be based on compliance with ASTM D 3740. No work requiring testing will be permitted until the Contractor's facilities have been inspected and approved.

1.6.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.6.2 Testing

1.6.2.1 Gradation

Aggregate gradation shall be made in conformance with ASTM C 117, ASTM C 136, and ASTM D 422. Sieves shall conform to ASTM E 11.

1.6.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.6.3 Approval of Materials

The source of the material to be used for producing aggregates shall be selected 14 days prior to the time the material will be required in the work. Approval of sources not already approved by the Corps of Engineers will be based on an inspection by the Contracting Officer. Tentative approval of materials will be based on appropriate test results on the

aggregate source. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted surface course.

1.7 WEATHER LIMITATIONS

Aggregate surface courses shall not be constructed when the ambient temperatures is below 35 degrees F and on subgrades that are frozen or contain frost. It shall be the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Surfaces damaged by freeze, rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor shall be responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction and proof rolling operations have been completed.

2.1.1 Coarse Aggregates

The material retained on the No. 4 sieve shall be known as coarse aggregate. Coarse aggregates shall be reasonably uniform in density and quality. The coarse aggregate shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ASTM C 131. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein.

2.1.2 Fine Aggregates

The material passing the No. 4 sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

Gradation requirements specified in TABLE I shall apply to the completed aggregate surface. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface roads and airfields. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES

Sieve Designation	No. 2
1 in.	100
3/8 in.	60-100
No. 4	50-85
No. 10	40-70

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES

Sieve Designation	No. 2
No. 40	24-45
No. 200	8-15

## 2.2 LIQUID LIMIT AND PLASTICITY INDEX REQUIREMENTS

The portion of the completed aggregate surface course passing the No. 40 sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

## PART 3 EXECUTION

### 3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specification requirements in the specified time limit. Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

### 3.2 STOCKPILING MATERIALS

Prior to stockpiling the material, the storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled in such a manner that will prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

### 3.3 PREPARATION OF UNDERLYING COURSE SUBGRADE

The subgrade, including shoulders, shall be cleaned of all foreign substances. At the time of surface course construction, the subgrade shall contain no frozen material. Ruts or soft yielding spots in the subgrade areas having inadequate compaction and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompacting to density requirements specified in Section 02300 EARTHWORK. The completed subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the surface course is placed.

### 3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course shall be maintained by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CONTRACT REQUIREMENTS.

### 3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the material and a uniform optimum water content for compaction. The Contractor shall make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

### 3.6 LAYER THICKNESS

The aggregate material shall be placed on the subgrade in layers of uniform thickness. When a compacted layer of 6 inches or less is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

### 3.7 COMPACTION

Each layer of the aggregate surface course shall be compacted with approval compaction equipment. The water content during the compaction procedure shall be maintained at optimum or at the percentage specified by the Contracting Officer. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

### 3.8 NOT USED

### 3.9 EDGES OF AGGREGATE-SURFACED ROAD

Approved material shall be placed along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least 1 foot of shoulder width shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the surface course.

### 3.10 SMOOTHNESS TEST

The surface of each layer shall not show any deviations in excess of 3/8 inch when tested with a 10 foot straightedge applied both parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by the Contractor by removing material, replacing with new material, or reworking existing material and compacting, as directed.

### 3.11 THICKNESS CONTROL

The completed thickness of the aggregate surface course shall be within 1/2 inch, plus or minus, of the thickness indicated on plans. The thickness of the aggregate surface course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of the aggregate surface course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course. When the measured thickness of the aggregate surface course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to the Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed. Where the measured thickness of the aggregate surface course is more than 1/2 inch) thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated. When the average job thickness fails to meet this criterion, the Contractor shall, at no additional expense to the Government, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed.

### 3.12 DENSITY TESTS

Density shall be measured in the field in accordance with ASTM D 1556, ASTM

D 2167, or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals, as directed.

### 3.13 WEAR TEST

Wear tests shall be made in conformance with ASTM C 131.

### 3.14 MAINTENANCE

The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --

## SECTION 02741

## BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density (Unit Weight) and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 183	(1995a) Sampling and the Amount of Testing of Hydraulic Cement
ASTM D 5	(1995) Penetration of Bituminous Materials
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous Paving Mixtures
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 946	(1982; R 1993) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 1856	(1995a) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock

ASTM D 3515 (1996) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

ASTM D 4791 (1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

## NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT)

NJDOT Standard Specifications for Road and Bridge Construction (Current Edition)

## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-09 Reports

Bituminous Pavement; GA.

Copies of test results.

## SD-14 Samples

Bituminous Pavement; GA.

Samples of the materials in the quantities indicated below for the job mix formula when requested by the Contracting Officer.

Aggregate and mineral filler (if needed) to be blended in approximately the same proportions as used in the project	200 pounds
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Asphalt Cement	5 gallons
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Aggregate samples when new sources are developed, with a plan for operation, 14 days before starting production. Samples of the asphalt cement specified, not less than 7 days before production.

## 1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

## 1.4.1 General

The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.

## 1.4.2 Mixing Plants

The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). The plant shall have a minimum capacity of 250 tons per hour. Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

#### 1.4.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 12-foot straightedge for each bituminous paver. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

#### 1.5 WEATHER LIMITATIONS

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 40 degrees F.

#### 1.6 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

#### 1.7 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

##### 1.7.1 Plan Grade

The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

##### 1.7.2 Surface Smoothness

When a 12-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 1/4 inch from the straightedge.

#### 1.8 GRADE CONTROL

Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work in accordance with the Special Contract Requirements. Elevations of bench marks used by the Contractor for controlling pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

#### 1.9 SAMPLING AND TESTING

##### 1.9.1 Aggregates

##### 1.9.1.1 General

When requested by the Contracting Officer, samples of aggregates shall be furnished by the Contractor for approval of aggregate sources and stockpiles prior to the start of production and at times during production of the bituminous mixtures. Times and points of sampling will be designated by the Contracting Officer. Samples will be the basis of approval of specific sources or stockpiles of aggregates for aggregate requirements. Unless otherwise directed, ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler. All tests necessary to determine compliance with

requirements specified herein will be made by the Government.

#### 1.9.1.2 Sources

Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, evidence shall be submitted 30 days before starting production, indicating that the central-plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. The Contracting Officer will make such tests and other investigations as necessary to determine whether aggregates meeting requirements specified herein can be produced from proposed sources. If a sample of material from a new source fails to meet specification requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample will be at the expense of the Contractor. Approval of the source of aggregate does not relieve the Contractor of responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

#### 1.9.2 Bituminous Materials

When requested by the Contracting Officer, samples of bituminous materials shall be obtained by the Contractor; sampling shall be in accordance with ASTM D 140. Tests necessary to determine conformance with requirements specified herein will be performed by the Government without cost to the Contractor. Sources where bituminous materials are obtained shall be selected in advance of the time when materials will be required in the work. In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure some condition of handling or storage has not been detrimental to the bituminous material. The samples will be taken by the Contractor and tested by the Contracting Officer.

#### 1.9.3 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by the Contracting Officer.

### 1.10 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

#### 1.10.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

#### 1.10.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh buckets shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

#### 1.11 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of

materials; and checking temperatures maintained in preparation of the mixtures.

## PART 2 PRODUCTS

### 2.1 BITUMINOUS HOT MIX

Bituminous hot mix shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the qualities and in the proportions specified and shall conform to the requirements contained in NJDOT 903 for I-4 surface course and I-2 base (intermediate) course.

#### 2.1.1 Aggregates

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screening, sand, and mineral filler, as required. The portion of materials retained on the No. 4 sieve shall be known as coarse aggregate, the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate, and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in TABLE I. TABLE I is based on aggregates of uniform specific gravity; the percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentage passing various sieves may be changed by the Contracting Officer when aggregates vary by more than 0.2 in specific gravity.

Aggregate shall meet the requirements of the New Jersey Department of Transportation for bituminous hot mix pavements.

##### 2.1.1.1 Coarse Aggregate

Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

a. Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

b. Percentage of loss shall not exceed 50 after five cycles performed in accordance with ASTM C 88, using magnesium sulfate.

c. The dry weight of crushed slag shall not be less than 75 pcf, as determined in accordance with ASTM C 29/C 29M.

d. Crushed gravel retained on the No. 4 sieve and each coarser sieve shall contain at least 75 percent by weight of crushed pieces having one or more fractured faces with the area of each face equal to at least 75 percent of the smallest midsectional area of piece. When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as two fractured faces.

e. Particle shape of crushed aggregates shall be essentially cubical. The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with ASTM D 4791.

##### 2.1.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles, including natural sand or crushed stone, slag, or gravel that meets requirements for wear and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve. This requirement shall apply to the material before blending with natural sand when blending is necessary. Quantity of natural sand to be added to the wearing- and intermediate-course mixtures shall not

exceed 25 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter. Percentage of loss shall not exceed 50 after five cycles of the soundness test performed in accordance with ASTM C 88, using magnesium sulfate.

2.1.1.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

Grain size shall be determined in accordance with ASTM D 422.

2.1.2 Bituminous Material

Asphalt cement shall conform to ASTM D 946, Grade AC-10.

2.1.3 Additives

The use of additives such as antistripping and antifoaming agents is subject to approval.

2.2 PROPORTIONING OF MIXTURE

2.2.1 Job Mix Formula

The JMF for the bituminous mixture will be furnished by the Contractor to the Contracting Officer. No payment will be made for mixtures produced prior to the approval of the JMF. The formula will indicate the percentage of each stockpile and mineral filler, the percentage of each size aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. Tolerances are given in TABLE II for asphalt content, temperature, and aggregate grading for tests conducted on the mix as discharged from the mixing plant; however, the final evaluation of aggregate gradation and asphalt content will be based on paragraph ACCEPTABILITY OF WORK. Bituminous mix that deviates more than 25 degrees F from the JMF shall be rejected. The JMF may be adjusted during construction to improve paving mixtures, as directed, without adjustments in the contract unit prices.

TABLE II. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	4 percent
Aggregate passing Nos. 100 and 200 sieves	2 percent
Bitumen	0.25 percent
Temperature of mixing	25 degrees F

2.2.2 Test Properties of Bituminous Mixtures

Finished mixture shall meet requirements described below. All samples will be compacted with 50 blows of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

2.2.2.1 Stability, Flow, and Voids

Requirements for stability, flow, and voids are shown in TABLES III and IV for nonabsorptive and absorptive aggregates, respectively.

TABLE III. NONABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
	<hr/>	<hr/>
Stability minimum, pounds	500	500
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	3-5	4-6
Voids filled with bitumen, percent (2)	75-85	65-75

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

TABLE IV. ABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
	<hr/>	<hr/>
Stability minimum, pounds	500	500
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	2-4	3-5
Voids filled with bitumen, percent (2)	80-90	70-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

a. When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet requirements in TABLE III.

b. When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in TABLE IV.

### PART 3 EXECUTION

#### 3.1 BASE COURSE CONDITIONING

The surface of the base course will be inspected for adequate compaction and surface tolerances specified in Section 02722 GRADED CRUSHED AGGREGATE BASE COURSE. Unsatisfactory areas shall be corrected.

#### 3.2 NOT USED

#### 3.3 PREPARATION OF BITUMINOUS MIXTURES

Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

#### 3.4 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with ASTM D 2216; the weight of the sample shall be at least 500 grams. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

#### 3.5 STORAGE OF BITUMINOUS PAVING MIXTURE

Storage shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

#### 3.6 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

#### 3.7 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of the intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

#### 3.8 PRIME COATING

Surfaces of previously constructed base course shall be sprayed with a coat of bituminous material conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS.

#### 3.9 TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS.

#### 3.10 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided.

##### 3.10.1 Offsetting Joints

The wearing course shall be placed so that longitudinal joints of the wearing course will be offset from joints in the intermediate course by at least 1 foot. Transverse joints in the wearing course shall be offset by

at least 2 feet from transverse joints in the intermediate course.

### 3.10.2 General Requirements for Use of Mechanical Spreader

Range of temperatures of mixtures, when dumped into the mechanical spreader, shall be as determined by the Contracting Officer. Mixtures having temperatures less than 225 degrees F when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to center line areas with crowned sections or high side of areas with one-way slope shall be as directed. Each lot of material placed shall conform to requirements specified in paragraph ACCEPTABILITY OF WORK. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected.

### 3.10.3 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by use of a lute. Excess mixture shall be removed and wasted.

### 3.10.4 Handspreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

## 3.11 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness will be checked in each lot of completed pavement by the Contracting Officer for compliance and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. After the Contractor is assured of meeting crown, grade, and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

### 3.11.1 Testing of Mixture

At the start of the plant operation, a quantity of mixture shall be prepared that is sufficient to construct a test section at least 50 feet long, two spreader widths wide and of thickness to be used in the project. Mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with the requirements specified above. This test section shall be tested and evaluated as a lot and shall conform to all specified requirements. If test results are satisfactory, the test

section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately, and test section will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. Additional test sections, as directed, shall be constructed and sampled for conformance to specification requirements. In no case shall the Contractor start full production of an intermediate or wearing course mixture without approval.

### 3.11.2 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

### 3.12 JOINTS

#### 3.12.1 General

Joints between old and new pavements, between successive work days, or joints that have become cold (less than 175 degrees F) shall be made to ensure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to Section 02748 BITUMINOUS TACK AND PRIME COATS. Material shall be applied far enough in advance of placement of a fresh mixture to ensure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

#### 3.12.2 Transverse Joints

The roller shall pass over the unprotected end of a strip of freshly placed material only when placing is discontinued or delivery of the mixture is interrupted to the extent that the material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of a strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

#### 3.12.3 Longitudinal Joints

Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density specified in paragraph ACCEPTABILITY OF WORK.

### 3.13 ACCEPTABILITY OF WORK

#### 3.13.1 NOT USED

#### 3.13.2 NOT USED

#### 3.13.3 NOT USED

3.13.4 NOT USED

3.13.5 NOT USED

3.13.6 Surface Smoothness

After completion of final rolling of a lot, the compacted surface will be tested by the Contracting Officer with a 12-foot straightedge. Measurements will be made perpendicular to and across all mats at distances along the mat not to exceed 25 feet. Location and deviation from straightedge of all measurements will be recorded. Any joint or mat area surface deviation which exceeds the tolerance given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

-- End of Section --

## SECTION 02748

## BITUMINOUS TACK AND PRIME COATS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 81 (1992) Cut-Back Asphalt (Rapid-Curing Type)

AASHTO T 40 (1978; R 1983) Sampling Bituminous  
Materials

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 140 (1993) Sampling Bituminous Materials

ASTM D 2028 (1976; R 1992) Cutback Asphalt  
(Rapid-Curing Type)

ASTM D 2995 (1993) Determining Application Rate of  
Bituminous Distributors

## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Tests; FIO.

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

## 1.4 PLANT, EQUIPMENT, MACHINES AND TOOLS

## 1.4.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

## 1.4.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and

equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

#### 1.4.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

#### 1.5 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 50 degrees Fahrenheit or above and when the temperature has not been below 35 degrees Fahrenheit for the 12 hours prior to application.

### PART 2 PRODUCTS

#### 2.1 TACK COAT

Cutback asphalt shall conform to ASTM D 2028 or AASHTO M 81 Grade RC-70.

#### 2.2 PRIME COAT

Cutback asphalt shall conform to ASTM D 2028 or AASHTO M 81, Grade RC-70 or RC-250.

### PART 3 EXECUTION

#### 3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

#### 3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

##### 3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

##### 3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

#### 3.3 APPLICATION TEMPERATURE

##### 3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

### 3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

#### Liquid Asphalts

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RC-70	120-200 degrees F*
RC-250	165-250 degrees F*

\*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

### 3.4 APPLICATION

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

### 3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

### 3.6 FIELD QUALITY CONTROL

Samples of the bituminous material used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

### 3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

#### 3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in

accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

### 3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

### 3.7.3 NOT USED

### 3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 02763  
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952 (Rev D) Paint, Traffic and Airfield  
Marking, Waterborne (Metric)

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA.

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

SD-06 Instructions

Mixing, Thinning and Application; FIO.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-08 Statements

Qualifications; FIO.

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-09 Reports

Material Tests; GA.

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-13 Certificates

Volatile Organic Compound (VOC) Content; GA.

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

#### 1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

#### 1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

##### 1.5.1 NOT USED

##### 1.5.2 NOT USED

##### 1.5.3 NOT USED

##### 1.5.4 NOT USED

##### 1.5.5 NOT USED

##### 1.5.6 NOT USED

##### 1.5.7 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

#### 1.6 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

#### 1.7 MAINTENANCE OF TRAFFIC

##### 1.7.1 NOT USED

##### 1.7.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

#### 1.8 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

## PART 2 PRODUCTS

### 2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

### 2.2 NOT USED

#### 2.2.1 NOT USED

#### 2.2.2 NOT USED

#### 2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

#### 2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

#### 3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

### 3.1.2 NOT USED

### 3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

## 3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

### 3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint.

Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

#### 3.2.1.1 Rate of Application

a. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

#### 3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

-- End of Section --

## SECTION 02770

## CONCRETE SIDEWALKS AND CURBS AND GUTTERS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 (1994) Steel Welded Wire Fabric, Plain,  
for Concrete Reinforcement

ASTM C 31/C 31M (1996) Making and Curing Concrete Test  
Specimens in the Field

ASTM C 143 (1990a) Slump of Hydraulic Cement Concrete

ASTM C 171 (1997) Sheet Materials for Curing Concrete

ASTM C 172 (1990) Sampling Freshly Mixed Concrete

ASTM C 173 (1996) Air Content of Freshly Mixed  
Concrete by the Volumetric Method

ASTM C 231 (1997) Air Content of Freshly Mixed  
Concrete by the Pressure Method

ASTM C 309 (1997) Liquid Membrane-Forming Compounds  
for Curing Concrete

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint  
Filler for Concrete Paving and Structural  
Construction (Nonextruding and Resilient  
Bituminous Types)

ASTM D 1752 (1984; R 1996) Preformed Sponge Rubber and  
Cork Expansion Joint Fillers for Concrete  
Paving and Structural Construction

ASTM D 3405 (1996) Joint Sealants, Hot-Applied, for  
Concrete and Asphalt Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 527 (1988) Standard Specification for Joint  
Sealants, Cold-Applied,  
Non-Jet-Fuel-Resistant, for Rigid and  
Flexible Pavements

## 1.2 NOT USED

## 1.3 NOT USED

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-09 Reports

Field Quality Control; GA.

Copies of all test reports within 24 hours of completion of the test.

## SD-18 Records

Concrete; FIO.

Copies of certified delivery tickets for all concrete used in the construction.

## 1.5 WEATHER LIMITATIONS

## 1.5.1 Placing During Cold Weather

Concrete placement shall be discontinued when the air temperature reaches 40 degrees F and is falling. Placement may begin when the air temperature reaches 35 degrees F and is rising. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

## 1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F.

## 1.6 PLANT, EQUIPMENT, MACHINES, AND TOOLS

## 1.6.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

### 1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

## PART 2 PRODUCTS

### 2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

#### 2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

#### 2.1.2 Slump

The concrete slump shall be 3 inches where determined in accordance with ASTM C 143.

#### 2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A, ASTM A 616/A, or ASTM A 617/A. Wire mesh reinforcement shall conform to ASTM A 185.

### 2.2 CONCRETE CURING MATERIALS

#### 2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

#### 2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

#### 2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

### 2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

### 2.4 JOINT FILLER STRIPS

#### 2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

#### 2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 3/8 inch thick, unless otherwise indicated.

## 2.5 JOINT SEALANTS

### 2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

### 2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

## 2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 2 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

### 2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

### 2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

## PART 3 EXECUTION

### 3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 02300 EARTHWORK.

#### 3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

#### 3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a

template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

### 3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

## 3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

### 3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

### 3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

## 3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

### 3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a wood float, bull float, or darby, edged and broom finished.

### 3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.

### 3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

### 3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straight edge. Permissible deficiency in section thickness will be up to 1/4 inch.

## 3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

### 3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

### 3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

### 3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

### 3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

### 3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straight edge. Permissible deficiency in section thickness will be up to 1/4 inch.

## 3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width.

Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

### 3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

### 3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 3/8 inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material.

Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

### 3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

## 3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

### 3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

### 3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 3/8 inch in width shall be provided at intervals not exceeding 20 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and

gutter contraction-joints shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

### 3.7 CURING AND PROTECTION

#### 3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

##### 3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

##### 3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

##### 3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing

compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

### 3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

### 3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

### 3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

#### 3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

#### 3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F.

## 3.8 FIELD QUALITY CONTROL

### 3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing.

Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

### 3.8.2 Concrete Testing

### 3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

### 3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231.

ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector.

If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

### 3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

### 3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine.

If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

### 3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

## 3.9 SURFACE DEFICIENCIES AND CORRECTIONS

### 3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

### 3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or

by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch.

Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

### 3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

## SECTION 02821

## FENCING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 121	(1992a) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(1995) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1992) Aluminum-Coated Steel Barbed Wire
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM F 626	(1996) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Chain Link Fence; GA.

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

#### SD-19 Operation and Maintenance Manuals

### PART 2 PRODUCTS

#### 2.1 FENCE FABRIC

Fence fabric shall conform to the following:

##### 2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 2.0 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

#### 2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

#### 2.3 POSTS

##### 2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II, formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

#### 2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line

posts are furnished.

## 2.5 WIRE

### 2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

## 2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

## 2.7 NOT USED

## 2.8 CONCRETE

ASTM C 94, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

### 3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 2 inch clearance between the bottom of the fabric and finish grade.

### 3.3 POST INSTALLATION

#### 3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in

concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

### 3.4 RAILS

#### 3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

### 3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12 foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

### 3.6 TENSION WIRES

Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 1 foot of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

### 3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 24 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 plus or minus 1/2 inch above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the

panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

### 3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

#### 3.8.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in a manner to prevent easy removal with hand tools. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

### 3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal. For farm style fencing, standard metal gate assemblies with frame and fittings necessary for complete installation or wood gates shall be furnished as shown.

### 3.10 NOT USED

### 3.11 GROUNDING

Fences crossed by overhead powerlines in excess of 600 volts shall be grounded as specified in Section 13100 LIGHTNING PROTECTION SYSTEM. Electrical equipment attached to the fence shall be grounded as specified in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL or Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

-- End of Section --

## SECTION 02921

## SEEDING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Aug 95) Federal Seed Act Regulations Part 201

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials  
 ASTM D 977 (1991) Emulsified Asphalt  
 ASTM D 2028 (1976; R 1992) Cutback Asphalt (Rapid-Curing Type)  
 ASTM D 4972 (1995a) pH of Soils  
 ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes  
 ASTM D 5883 (1996) Standard Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

## NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT)

NJDOT Standard Specifications for Road and Bridge Construction (Current Edition)

## NEW JERSEY STATE SOIL CONSERVATION COMMITTEE (NJSSCC)

NJSSCC Standards for Soil Erosion and Sediment Control in New Jersey, 1987

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Surface Erosion Control Material; FIO. Chemical Treatment Material; FIO.

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

## SD-07 Schedules

Equipment; FIO.

A listing of equipment to be used for the seeding operation.

## SD-08 Statements

Delivery; GA.

Delivery schedule.

Topsoil; FIO.

Availability of topsoil from the stripping and stock piling operation.

## SD-09 Reports

Equipment Calibration; FIO.

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; GA.

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

## SD-13 Certificates

Seed; GA. Topsoil; GA. pH Adjuster; FIO. Fertilizer; GA. Organic Material; FIO. Soil Conditioner; FIO. Mulch; FIO. Asphalt Adhesive; FIO. Pesticide; FIO.

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.
- h. Asphalt Adhesive: Composition.
- i. Pesticide. EPA registration number and registered uses.

## SD-18 Records

Quantity Check; GA.

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; FIO.

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record; GA.

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide; FIO.

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

### 1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

### 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

#### 1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

##### 1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

##### 1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

##### 1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

#### 1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

#### 1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

#### 1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

#### 1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

### PART 2 PRODUCTS

#### 2.1 SEED

##### 2.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

##### 2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be as specified in NJSSCL.

##### 2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be in accordance with NJSSCC.

##### 2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

##### 2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

##### 2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

#### 2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268 and NJSSCC. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

#### 2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

#### 2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

##### 2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To raise soil pH, ground limestone shall be used.

##### 2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

##### 2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

#### 2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

##### 2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

#### 2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

##### 2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

##### 2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

##### 2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

#### 2.3.4.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 3/8 inch screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 2 inches in length.

#### 2.3.4.5 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

#### 2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

##### 2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

##### 2.3.5.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrile, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

##### 2.3.5.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

##### 2.3.5.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

##### 2.3.5.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

## 2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

### 2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

### 2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

### 2.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

### 2.4.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

## 2.5 ASPHALT ADHESIVE

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

## 2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

## 2.7 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

## 2.8 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

### 2.8.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

### 2.8.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

### 2.8.3 Erosion Control Geomatrix

A semi-rigid, three dimensional geomatrix shall be provided for erosion control on earth-covered magazines. Material shall be a non-woven polyester fabric with a cell height of 4 inches and a minimum cell area of 200 square inches. Cells shall be backfilled with NJDOT No. 1 stone. Installation shall follow manufacturer's recommendations.

### 2.8.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

### 2.8.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

### 2.8.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLING SEED TIME AND CONDITIONS

#### 3.1.1 Seeding Time

Seed shall be installed from Feb. 15 to May 1 for spring establishment; and from Aug. 15 to Oct. 15 for fall establishment.

#### 3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

#### 3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

#### 3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

### 3.2 SITE PREPARATION

### 3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the seeding operation.

### 3.2.2 Application of Soil Amendments

#### 3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage operation.

#### 3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage or hydroseeding operation.

#### 3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 1 inch depth and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

#### 3.2.2.4 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

### 3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 4 inch depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

### 3.2.4 Prepared Surface

#### 3.2.4.1 Preparation

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

#### 3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 5/8 inch in any dimension shall be removed from the surface.

#### 3.2.4.3 Field Area Debris

Debris and stones over a minimum 3 inch in any dimension shall be removed

from the surface.

#### 3.2.4.4 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

### 3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

#### 3.3.1 Installing Seed

Seeding method shall be broadcast seeding, drill seeding or hydroseeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

##### 3.3.1.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 2.1 pounds per 1000 square feet using broadcast seeders. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device.

##### 3.3.1.2 Drill Seeding

Seed shall be uniformly drilled to a maximum 1/2 inch depth and at the rate of 2.1 pounds per 1000 square feet, using equipment having drills a maximum 7 inches distance apart. Row markers shall be used with the drill seeder. Half the total rate of seed application shall be drilled in 1 direction, with the remainder of the seed rate drilled at 90 degrees from the first direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations.

##### 3.3.1.3 Rolling

The entire area shall be firmed with a roller not exceeding 90 pounds per foot roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

#### 3.3.2 Hydroseeding

Seed shall be mixed to ensure broadcast at the rate of 2.1 pounds per 1000 square feet. Seed and fertilizer shall be added to water and thoroughly mixed to meet the rates specified. The time period for the seed to be held in the slurry shall be a maximum 24 hours. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

#### 3.3.3 Mulching

##### 3.3.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of

relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

#### 3.3.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

#### 3.3.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

#### 3.3.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

#### 3.3.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

#### 3.3.3.6 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

#### 3.3.4 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

### 3.4 SURFACE EROSION CONTROL

#### 3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

#### 3.4.2 Temporary Seeding

The application rate shall be 9.0 pounds per 1000 square yards. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

#### 3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

#### 3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

### 3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

### 3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

#### 3.6.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

#### 3.6.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

### 3.7 RESTORATION AND CLEAN UP

#### 3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

#### 3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

### 3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area

shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

### 3.9 SEED ESTABLISHMENT PERIOD

#### 3.9.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of work under this contract and shall end 3 months after the last day of the seeding operation. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

#### 3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

##### 3.9.2.1 Lawn Area

A satisfactory stand of grass plants from the seeding operation for a lawn area shall be a minimum 20 grass plants per square foot. Bare spots shall be a maximum 6 inches square. The total bare spots shall be a maximum 2 percent of the total seeded area.

#### 3.9.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

##### 3.9.3.1 Mowing

- a. Lawn Areas: Lawn areas shall be mowed to a minimum 3 inch height when the turf is a maximum 4 inches high. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

##### 3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 1/2 pound per 1000 square feet of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

##### 3.9.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

##### 3.9.3.4 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

##### 3.9.3.5 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance

work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

## SECTION 03250

## EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1982; R 1988) Basic Hardboard

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2628 (1991) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D 2835 (1989; R 1993) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

## FEDERAL SPECIFICATIONS (FS)

FS SS-S-1401 (Rev C; Am 1; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300SUBMITTAL PROCEDURES:

SD-01 Data

Materials; FIO.

Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

SD-13 Certificates

Materials; FIO.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

### 1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

## PART 2 PRODUCTS

### 2.1 CONTRACTION-JOINT STRIPS

Contraction-joint strips shall be 1/8 inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

### 2.2 EXPANSION-JOINT FILLER

Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed.

### 2.3 JOINT SEALANT

Joint sealant shall conform to the following:

#### 2.3.1 Preformed Polychloroprene Elastomeric Joint Seals

ASTM D 2628.

#### 2.3.2 Lubricant for Installation of Preformed Compression Seals

ASTM D 2835.

#### 2.3.3 Hot-Poured Type

FS SS-S-1401.

## PART 3 EXECUTION

### 3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

#### 3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC insert strips into the plastic concrete or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab approximately one-fourth the slab thickness but not less than 1 inch.

##### 3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of

the strips is maintained during insertion.

#### 3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete-sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

#### 3.1.2 Expansion Joints

Premolded expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4 inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

#### 3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Types and locations of sealants shall be as indicated. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant. Joints sealed with field molded sealant shall be completely filled with sealant.

-- End of Section --

## SECTION 03300

## CONCRETE FOR BUILDING CONSTRUCTION

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1981; Rev 1985) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1984; Rev 1988) Structural Concrete for Buildings
ACI 305R	(1989) Hot Weather Concreting
ACI 318	(1989) Building Code Requirements for Reinforced Concrete
ACI 347	(1988) Concrete Formwork

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1982; R 1988) Basic Hardboard
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615	(1989) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	(1988) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1986) Concrete Aggregates
ASTM C 39	(1986) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1987) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	(1984) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94	(1989b) Ready-Mixed Concrete
ASTM C 143	(1989a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1989) Portland Cement

ASTM C 171 (1969; R 1986) Sheet Materials for Curing Concrete

ASTM C 172 (1982) Sampling Freshly Mixed Concrete

ASTM C 173 (1978) Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C 192 (1988) Making and Curing Concrete Test Specimens in the Laboratory

ASTM C 231 (1989a) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260 (1986) Air-Entraining Admixtures for Concrete

ASTM C 309 (1989) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 330 (1987) Lightweight Aggregates for Structural Concrete

ASTM C 494 (1986) Chemical Admixtures for Concrete

ASTM C 597 (1983) Pulse Velocity Through Concrete

ASTM C 618 (1989) Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

ASTM C 803 (1982; R 1989) Penetration Resistance of Hardened Concrete

ASTM C 805 (1985) Rebound Number of Hardened Concrete

ASTM C 1017 (1985) Chemical Admixtures for Use in Producing Flowing Concrete

ASTM D 1751 (1983) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM E 96 (1990) Water Vapor Transmission of Materials

## CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI DA4 (1990; 25th Ed) Manual of Standard Practice

## DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1983) Construction and Industrial Plywood

## FEDERAL SPECIFICATIONS (FS)

FS CCC-C-467	(Rev C) Cloth, Burlap, Jute (or Kenaf)
FS SS-S-1401	(Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

## NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA-01	(Jan 1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready-Mixed Concrete Production Facilities
NRMCA CPMB-100	(Jan 1986) Concrete Plant Standards
NRMCA TMMB-1	(Jan 1982; 11th Rev) Truck Mixer and Agitator Standards

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## SD-04 Drawings

Concrete Reinforcement System; GA

Detail drawings showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

## SD-08 Statements

Proportions of Mix; FIO.

The results of trial mix along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory.

## SD-09 Reports

Sampling and Testing; FIO.

Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, cement, pozzolan, joint sealant, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials.

## SD-13 Certificates

Cementitious Materials; FIO.

Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.  
Reinforcing Steel; FIO

Certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.

1.4 GENERAL REQUIREMENTS

1.4.1 Strength Requirements

Structural concrete for all work except slabs on-grade shall have a 28-day compressive strength of 4000 pounds per square inch. Concrete slabs on-grade shall have a 28-day flexural strength of 600 pounds per square inch. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement.

1.4.2 Air Entrainment

Concrete exposed to freeze-thaw cycles shall contain from 5 to 7 percent total air. Other concrete may, at the option of the Contractor, be air entrained to produce concrete with 3 to 5 percent total air.

1.4.3 Special Properties

Concrete may contain other admixtures, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if approved.

1.4.4 Slump

Slump shall be within the following limits:

<u>Structural Element</u>	<u>Slump in inches</u>	
	<u>Minimum</u>	<u>Maximum</u>
Blast and Fragment Resistant Walls	4	6
Foundation walls, substructure walls, footings, pavement, and slabs	1	3
Any structural concrete approved for placement by pumping	None	6

\*Where use of superplasticizers are approved to produce flowing concrete these slump requirements do not apply.

1.5 PROPORTIONS OF MIX

1.5.1 Mixture Proportioning

Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of

concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength.

1.5.2 Average Strength

In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

1.5.2.1 Test Records Exceeding 29

Required average compressive strength used as the basis for selection of concrete proportions shall be the larger of the specified strength plus the standard deviation multiplied by 1.34 or the specified strength plus the standard deviation multiplied by 2.33 minus 500.

1.5.2.2 Test Records Less Than 29

Where a concrete production facility does not have test records meeting the above requirements but does have a record based on 15 to 29 consecutive tests, a standard deviation may be established as the product of the calculated standard deviation and a modification factor from the following table:

No. of tests (1)	Modification factor for standard deviation
less than 15	See Note
15	1.16
20	1.08
25	1.03
30 or more	1.00

(1) Interpolate for intermediate numbers of tests.

When a concrete production facility does not have field strength test records for calculation of standard deviation or the number of tests is less than 15, the required average strength shall be:

- a. The specified strength plus 1000 specified strength of less than 3000 psi.
- b. The specified strength plus 1200 for specified strengths of 3000 to 5000 psi.

c. The specified strength plus 1400 for specified strengths greater than 5000 psi.

#### 1.6 STORAGE OF MATERIALS

Cement and pozzolan shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

#### 1.7 FORM DESIGN

Formwork shall be designed in accordance with methodology of ACI 347 for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

### PART 2 PRODUCTS

#### 2.1 ADMIXTURES

Admixtures shall conform to the following:

##### 2.1.1 Accelerating Admixture

ASTM C 494, Type C or E.

##### 2.1.2 Air-Entraining Admixture

ASTM C 260.

##### 2.1.3 Flowing Concrete Admixture

ASTM C 1017, Type 1 or 2.

##### 2.1.4 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D.

#### 2.2 CEMENTITIOUS MATERIALS

Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:

##### 2.2.1 Cement

ASTM C 150, Type I or II or III.

### 2.2.2 Pozzolan

ASTM C 618, Class N. When a pozzolan is used in a flexural strength concrete mix design, the solid volume of pozzolan when combined with portland cement shall not exceed 25 percent of the solid volume of portland cement plus pozzolan.

## 2.3 AGGREGATES

Aggregates shall conform to ASTM C 33. Maximum size of coarse aggregate shall be 1/2 inch for Blast and Fragment Resistant Walls and No. 57 for all other work.

## 2.4 CURING MATERIALS

### 2.4.1 Burlap

FS CCC-C-467.

### 2.4.2 Impervious Sheets

ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

### 2.4.3 Membrane-Forming Compounds

ASTM C 309, Type 1-D, Class A or B.

## 2.5 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application.

## 2.6 FORM MATERIALS

### 2.6.1 Forms For Class B Finish

Forms for Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

### 2.6.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used.

### 2.6.3 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. That portion of the tie remaining permanently in the concrete shall not project beyond the surface of the concrete and shall be at least 1 inch back from any concrete surface that will be exposed or dampproofed. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch

nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall not be more than 1-1/2 inches in diameter.

#### 2.6.4 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

#### 2.7 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615 Grade 60, sizes as indicated.

#### 2.8 WIRE TIES

Wire ties shall be 16-gauge or heavier black annealed steel wire.

#### 2.9 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI DA4 and shall be precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks.

#### 2.10 CONTRACTION-JOINT STRIPS

Contraction-joint strips shall be 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1.

#### 2.11 EXPANSION-JOINT FILLER

Expansion-joint filler shall be premolded material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8-inch thick and of a width applicable for the joint formed.

#### 2.12 JOINT SEALANT

Joint sealant shall be hot-poured type conforming to FS SS-S 1401.

#### 2.13 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96.

#### 2.14 WATER

Water shall be potable. Water for curing shall not contain any substance injurious to concrete, or which causes staining.

#### 2.15 DOWELS

Dowels shall conform to ASTM A 675, Grade 80, or ASTM A 499. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

#### 2.16 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184.

#### 2.17 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185 or ASTM A 497.

#### 2.18 NONSHRINK GROUT

Nonshrink grout shall conform to <RID>ASTM C 1107</RID> Grade A and shall be a formulation suitable for the application.

#### 2.19 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of fifty-five percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogenous material sufficiently porous to provide a good bond with portland paste; or factory-graded emery material consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The material shall be well graded from particles retained on the <MET>0.600 mm</MET> <ENG>No. 30</ENG> sieve to particles passing the <MET>2.36 mm</MET> <ENG>No. 8</ENG> sieve.

#### 2.20 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluoride can be used individually or in combination. Proprietary hardeners may be used if approved by the contracting officer.

#### 2.21 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to <RID>ASTM C 578</RID>, Type II; polyurethane conforming to <RID>ASTM C 591</RID>, Type II and having a minimum recovered material content of 9 percent by weight of core material in the polyurethane portion; or cellular glass conforming to <RID>ASTM C 552</RID>, Type I or IV. Polyurethane insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not involving material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided.

#### 2.22 INSULATED CONCRETE SANDWICH WALLS

Concrete sandwich wall panels shall be constructed as one unit, consisting of thermomass brand PC or CIP Fiber Composite Connectors which will hold the specially fabricated insulation, with an R-value of 5 per inch at 72 deg. F, in place and also connect the two 4-inch layers of concrete together such that they act as a composite panel.

The connectors shall have a tensile strength of 120 ksi, and a thermal conductivity of 2.1 BTU per sq. ft./hr./deg. F/in. The connection system shall not reduce the thermal resistance of the wall assembly by more than 2%. The system shall be in accordance with the thermal bridging provisions of <RID>ASHRAE 90.1</RID> and <RID>ASHRAE 90.2</RID>.</TXT>••</SPT =2.10>

### PART 3 EXECUTION

#### 3.1 PREPARATION OF SURFACES

Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.

##### 3.1.1 Foundations

Earthwork shall be as specified in Section 02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but without free water when concrete is placed. Semiporous subgrades for foundations and footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.

##### 3.1.2 Vapor Barrier

Subgrades for slabs in buildings shall be covered with a vapor barrier. Vapor barrier edges shall be lapped at least 4 inches and ends shall be lapped not less than 6 inches. Patches and lapped joints shall be sealed with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane.

##### 3.1.3 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

#### 3.2 FORMWORK

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified and conforming to construction tolerance given in TABLE 1. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

#### 3.3 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

#### 3.4 COATING OF FORMS

Forms for exposed surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written

instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.5 REMOVAL OF FORMS

Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Formwork for parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed until the structural units are strong enough to carry their own weight and any other construction or natural loads. In no case will supporting forms or shores be removed before the concrete strength has reached 70 percent of design strengths as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1.	Variations from the plumb:	In any 10 feet of length ---- 1/4 inch Maximum for entire length --- 1 inch
2.	Variation from the level or from the grades indicated on the drawings:	In any 10 feet of length ---- 1/4 inch In any 20 feet of length ---- 3/8 inch
a.	In slab soffits and ceilings, measured before removal of supporting shores	Maximum for entire length --- 3/4 inch
b.	In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ----- 1/4 inch Maximum for entire length --- 1/2 inch
3.	Variation of the linear building lines from established position in plan	In any 20 feet ----- 1/2 inch Maximum ----- 1 inch
4.	Variation of distance between walls	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total

variation

5.	Variation in the sizes and locations of wall openings	Minus ----- 1/4 inch Plus ----- 1/2 inch
6.	Variation in the thickness of slabs and walls	Minus ----- 1/4 inch Plus ----- 1/2 inch
7.	Footings:	
a.	Variation of dimensions in plan	Minus ----- 1/2 inch Plus ----- 2 inches when formed or plus 3 inches when  placed against unformed excavation
b.	Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ----- 2 inches
c.	Reduction in thickness	Minus ----- 5 percent of specified thickness

3.6 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.

3.6.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.6.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches.

3.7 INSTALLATION OF EMBEDDED ITEMS

Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

### 3.8 BATCHING, MIXING AND TRANSPORTING CONCRETE

Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-01. Site-mixed concrete shall be mixed in accordance with ACI 301. On-site plant shall conform to the NRMCA CPMB-100.

#### 3.8.1 Admixtures

Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing. Concrete that shows evidence of total collapse or segregation caused by the use of admixture shall be removed from the site.

#### 3.8.2 Control of Mixing Water

No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch except when on arrival at the jobsite, the slump of the concrete is less than that specified. Water added to bring the slump within the specified range shall not change the total water in the concrete to a point that the approved water-cement ratio is exceeded. The drum shall be turned an additional 30 revolutions, or more, if necessary, until the added water is uniformly mixed into the concrete. Water shall not be added to the batch at any later time.

### 3.9 SAMPLING AND TESTING

Sampling and Testing is the responsibility of the Contractor and shall be performed by an approved testing agency.

#### 3.9.1 Aggregates

Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C 33. Lightweight aggregate shall be sampled and tested in accordance with ASTM C 330. Gradation tests shall be performed on the first day and every other day thereafter during concrete construction.

#### 3.9.2 Sampling of Concrete

Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.

##### 3.9.2.1 Air Content

Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test per day shall be conducted.

##### 3.9.2.2 Slump

At least 2 slump tests shall be made on randomly selected batches of each mixture of concrete during each day's concrete placement. Tests shall be performed in accordance with ASTM C 143.

### 3.9.3 Evaluation and Acceptance of Concrete

#### 3.9.3.1 Frequency of Testing

Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent.

#### 3.9.3.2 Testing Procedures

Cylinders and beams for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39 and beams shall be tested in accordance with ASTM C 78. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days unless otherwise specified or approved.

#### 3.9.3.3 Evaluation of Results

Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch. For flexural strength concrete, the strength level of the concrete will be considered satisfactory if the averages of all sets of five consecutive strength test results equal or exceed the required flexural strength, and not more than 20 percent of the strength test results fall below the required strength by more than 100 pounds per square inch.

#### 3.9.4 Investigation of Low-Strength Test Results

When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by the Contracting Officer to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used a basis for acceptance or rejection. When strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by the Contracting Officer to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete

in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by the Contracting Officer, at the expense of the Contractor.

### 3.10 CONVEYING CONCRETE

Concrete shall be conveyed from mixer to forms as rapidly as possible and within the time interval specified in paragraph "CONCRETE PLACEMENT" by methods which will prevent segregation or loss of ingredients.

#### 3.10.1 Chutes

When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.

#### 3.10.2 Buckets

Bucket design shall be such that concrete of the required slump can be readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.

#### 3.10.3 Belt Conveyors

Belt conveyors may be used when approved. Belt conveyors shall be designed for conveying concrete and shall be operated to assure a uniform flow of concrete to the final place of deposit without segregation or loss of mortar. Conveyors shall be provided with positive means for preventing segregation of the concrete at transfer points and point of placement.

#### 3.10.4 Pumps

Concrete may be conveyed by positive displacement pumps when approved. The concrete shall be designed for pumping. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

### 3.11 CONCRETE PLACEMENT

Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by the Government if the concrete is of such slump after the 1-1/2

hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.

#### 3.11.1 Placing Operation

Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 8 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

#### 3.11.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for Blast and Fragment Resistant Walls and slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. Concrete in Blast and Fragment Resistant Walls shall be consolidated by placing manual vibration bars on the outside of the walls or by tapping with a rubber mallet. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

#### 3.11.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, chemical admixture conforming to ASTM C 494 Type C or E may be used.

#### 3.11.4 Warm Weather Requirements

The temperature of the concrete placed during warm weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

#### 3.12 CONSTRUCTION JOINTS

Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer except horizontal construction joints shall not be used in Blast and Fragment Resistant walls. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete walls shall be in place at least 2 hours, or until the concrete is no longer plastic, before placing concrete for slabs thereon. In walls having door openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph "PREPARATIONS OF SURFACES."

#### 3.13 FINISHING CONCRETE

##### 3.13.1 Formed Surfaces

Exposed surfaces shall have a Class B finish, and all other surfaces shall have a Class D finish.

##### 3.13.1.1 Repair of Surface Defects

Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by the Contracting Officer and finished slightly higher than the surrounding surface. For Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry-packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during

the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed.

#### 3.13.1.2 Class B Finish

Class B finish shall be provided for permanently exposed surfaces. All fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained through the use of Grade B-B plywood forms.

#### 3.13.1.3 Class C Finish

Class C finish shall be provided for surfaces that are not permanently exposed. All fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.

#### 3.13.2 Unformed Surfaces

In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 1/8 inch when tested with a 10-foot straightedge. Surfaces shall be pitched as indicated.

##### 3.13.2.1 Rough-Slab Finish

Slabs shall be screeded with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.

##### 3.13.2.2 Float Finish

Floor and roof slabs shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated.

##### 3.13.2.3 Trowel Finish

Slabs inside the magazine shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand.

##### 3.13.2.4 Broom Finish

After floating, exterior slabs on grade shall be lightly trowelled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

### 3.14 CURING AND PROTECTION

#### 3.14.1 General

All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type I or Type II cement	7 days
Concrete with Type I or Type II cement blended with pozzolan	7 days

Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.

#### 3.14.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap or saturated burlap.

#### 3.14.3 Membrane Curing

Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period. Surfaces coated with curing

compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

### 3.15 WELDED-WIRE FABRIC

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost cross wires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

### 3.16 DOWELS

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

### 3.17 PERIMETER INSULATION

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls.

#### 3.17.1 Insulated Concrete Sandwich Walls

Sandwich panel connectors and installation instructions shall be furnished by Composite Technologies Corporation, Amex, Iowa at 1-800-232-1748.

### 3.18 FLOOR HARDENER

Floor hardener shall be applied after the concrete had been air dried for 28 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, one pound of the silicofluoride shall be dissolved in one gallon of water. For subsequent applications, the solution shall be two pounds of silicofluoride to each gallon of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

-- End of Section --

## SECTION 03420

PLANT - PRECAST STRUCTURAL  
(CONTRACTOR'S OPTION)

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)  
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

ASTM A C150 or AASHTO	(1991) Portland Cement
ASTM C283	(1991) Low and intermediate tensile strength, carbon steel plates, shapes and bars
ASTM A 615	(1991) Deformed and plain billet steel bars for concrete reinforcement
ASTM C39	(1990) Compressive strength of cylindrical concrete specimen
ASTM C31	(1990) Making and curing concrete test specimens in the field
AASHTO T27	(1991) Sieve analysis of fine and coarse aggregates
AASHTO T236	(1991) Direct shear test of soils under consolidated drained conditions
AASHTO T99	(1990) Moisture-density relations of soils using a 5.5 lb (2.5kg) rammer and a 12 (305mm) drop

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300 SUBMITTALS:

SD-04, Drawings

Spread Footings Layout and Details; GA

Drawings shall include dimensions and overall plan layouts of footings based on in-situ conditions. They shall also include the number, size, type, and locations of all reinforcing steel bars in the footings.

SD-13, Certificates

Steel Panels; FIO

Certificates of compliance stating that the steel components inside the TechSpan™ precast element and the element fabrication conform to the requirements specified.

SD-20, Construction Methods and Procedures

TechSpan™ Arch System; FIO

Technical description of the materials, equipment, methods, procedures, and construction sequence to be used in constructing the TechSpan arch system, Procedures shall generally conform to those provided by the patent holder.

#### 1.4 STORAGE

TechSpan precast elements shall be stored on wooden bearers out of contact with the ground with a slope of 1:100 along the precast element length to prevent accumulation of water.

### PART 2 PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURER

The Contractor shall make his own arrangements to purchase the materials covered by this section of the specifications including concrete arch segments, joint materials, impermeable geomembrane, and all necessary incidentals from The Reinforced Earth Company (RECO), 8614 Westwood Center Drive, Suite 1100, Vienna, Virginia 22182 (Phone: 703-821-1175). The TechSpan™ system is protected by the U.S. Patent Number 4,826,639, application number 5212.

#### 2.2 PRECAST CONCRETE ARCH SYSTEM

##### 2.2.1 Concrete Reinforcement

ASTM A615 with 60,000 psi minimum yield strength.

##### 2.2.2 Concrete

1. Cement shall be Types I, II, or III, 3.0-6.0% air entrainment, and shall conform to the requirements of ASTM C150-86.
2. Concrete shall have a compressive strength at 28 days in accordance with Section 2.2.9.
3. Retarding or accelerating agents, or any additive containing chloride shall not be used without approval of RECO.
4. Concrete cover on reinforcement shall be 1" (25mm) minimum, unless otherwise indicated on the drawings.

##### 2.2.3 Steel Plates:

Steel plates shall be fabricated from A-283 steel plate material and bent in accordance with the drawings. Headed anchors shall be Nelson stud anchors (or approved equal), and shall be of the size and quantity indicated on the drawings. Headed anchors shall be welded to the bent steel plates in

accordance with the anchor manufacturer's recommendations. Steel plates shall be placed in the arch form prior to casting the arch segments and securely held in the proper position during the casting operation.

2.2.4 Casting:

Place concrete in arch unit without interruption and consolidate by use of an approved vibrator, supplemented by such hand-tamping as may be necessary to force the concrete into the corners of the forms. Formation of stone pockets or cleavage planes shall be prevented. Clear form oil from the same manufacturer shall be used throughout the casting operation. Lifting devices shall be set in place to the dimensions and tolerances shown on the drawings prior to casting.

2.2.5 Curing

Cure precast arch segments for a sufficient length of time so that the concrete will develop the specified compressive strength. Any production lot which does not conform to the strength requirements of Section 2.2.9 shall be rejected.

2.2.6 Removal of Forms

Maintain forms in place until concrete has cured to a suitable strength that will allow elements to be safely removed without damage.

2.2.7 Concrete Finish

The inside face of all arch elements shall have a smooth gray consistent finish. Consistency of finish shall be maintained with the use of the same concrete mix and same type of form oil for the entire project. The side edge(s) of the element shall have an unformed surface finish, trowelled with no open pockets or distortions in excess of 3/16" (5mm).

2.2.8 Allowable Tolerances

Manufacture all units within the following tolerances:

Chords and Diagonals

Dim. > than or = to		Arch Segment Tolerance	Average Lot tolerance
> than or = to	and < than		
0 ft	15.75 ft	± 3/16" (5mm)	± 3/16" (5mm)
15.75 ft (4.8m)	31.5 ft	±5/16" (8mm)	± 3/16" (5mm)
31.5 ft (9.6m)	47.25 ft	±1/2" (12mm)	± 1/4" (6mm)
47.25' (14.4m)	Larger	±3/4" (20mm)	± 3/8" (10mm)

1. TechSpan Element Width : +3/16" to -3/16" (+ 5mm to -5mm)
2. TechSpan Element Thickness: +9/16" to -3/16" (15mm to -5mm)
3. Arch Surface Finish: Surface defects on smooth formed surfaces of the precast arch section measured with a straight edge over a 4 ft (200mm) length shall not exceed 3/16" (5mm).
4. The average lot tolerance shall be rendered as an overall quality control check for comparison of arch segments cast within the same project.

### 2.2.9 Compressive Strength

1. Acceptance of the precast concrete arch elements, with respect to compressive strength, will be determined on the basis of production lots.
  - a. A production lot is defined as a group of precast concrete arch segments that will be represented by a single compressive strength sample and will consist of either eight arch elements or a single day's production, whichever is less.
2. During production of the precast concrete arch segments, the manufacturer will randomly sample the concrete in accordance with AASHTO T-141.
  - a. A single compressive strength sample, consisting of a minimum of four cylinders, will be randomly selected for every production lot.
3. Cylinders for compressive strength testing shall be prepared in accordance with ASTM C31 (Dimensions: 2 x Diameter = Height). For every compressive strength sample, a minimum of two cylinders shall be cured in the same manner as the arch segments and tested at approximately seven (7) days. The average compressive strength of these cylinders, when tested in accordance with ASTM C39, will provide a test result which will determine the initial strength of the concrete. In addition, two cylinders shall be cured in accord with ASTM C31 and tested at 28 days. The average compressive strength of these two cylinders, when tested in accordance with ASTM C39, will provide a compressive strength test result which will determine the compressive strength of the production lot.
4. If the initial strength test result indicates a compressive strength in excess of 4,000 psi (27.6 MPa), then that initial test result may be considered the compressive strength test for that production lot, and the requirement for further testing at 28 days may be waived for that same production lot. [Note: It may still be desirable to perform strength tests at 28 days to meet the requirements of production lot acceptance under Item 5]
5. Acceptance of a production lot will be made if the compressive strength test results is equal to or greater than 4000 psi (27.6 MPa). If the compressive strength test result is less than 4,000 (27.6 MPa) psi, the acceptance of the production lot will be based upon its meeting the following acceptance criteria in its entirety:
  - a. 90% percent of the compressive strength test result for all production lots shall exceed 4,150 psi (28.6 MPa).
  - b. The average of any six consecutive compressive strength test result shall exceed 4,250 psi (29.3 MPa).
  - c. No individual compressive strength test result shall fall below 3,600 psi (24.8 MPa).
6. In the event a production lot fails to meet the specified compressive strength requirements, the elements from the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at his own expense, obtains and submits evidence of a type acceptable to the Owner's Engineer that the strength and quality of the concrete placed within the elements of the production lot is acceptable.

- a. If such evidence consists of tests made on cores taken from the precast concrete arch segments within the production lot, the cores shall be obtained and tested in accordance with AASHTO T-24.

#### 2.2.10 Repairs at Fabrication Facility

1. It is recognized that certain cracks and surface defects may not be detrimental to the structural integrity of the arch unit and may be harmless if remedied by proper repair.
2. Before shipment, surfaces of all precast arch units shall be examined. The RECO Project Manager (PM) will determine the kind, type and extent of cracks and surface defects, such as honeycomb and chipped edges or corners that may be repaired. All such cracks and surface defects shall be repaired in a manner satisfactory to the PM.
3. If the PM determines that defective concrete unit(s) cannot be repaired properly and satisfactorily, the unit(s) shall be rejected.

#### 2.2.11 Marking

The date of manufacture, the production lot number, and the piece-mark shall be clearly inscribed on the unformed edge of each arch segment.

#### 2.2.12 Handling, Storage and Shipping

Handle, store and ship units in such a manner as to eliminate the danger of chipping, cracking, and excessive bending stresses. Precast concrete arch segments in storage shall be properly placed on edge on firm blocking on level ground to avoid damage or warping.

### 2.3 IMPERMEABLE GEOMEMBRANE

Impermeable geomembrane shall be Bituthene 3000 membrane as manufactured by the W.R. Grace Company or equal as approved by The Reinforced Earth Company.

### 2.4 FLOWABLE GROUT

High fluidity, non-ferrous, non-shrink grout as manufactured by the Burke Company or approved equal by The Reinforced Earth Company, shall be used after erection to grout the TechSpan elements into the keyway or recess in the cast-in-place footing. Grout shall have a compressive strength of at least 4,000 psi and shall meet Corps of Engineers CRD-C621-88 for all consistencies.

### 2.5 BACKFILL

#### 2.5.1 Select Granular Backfill

All select granular backfill material used around the TechSpan precast arch system in Zones 1 and 2, as indicated on the drawings, shall be free from organic or otherwise deleterious materials. In addition, the select granular backfill material shall conform to the following requirements:

1. The backfill material shall conform to the following gradation limits in accordance with AASHTO T-27.

Sieve Size

Percent Passing

3 inches (76mm)	100
3/4 inches (19 mm)	20-100
No. 40 (0.425 mm)	0-60
No.200 (0.075 mm)	0-15

2. The material shall exhibit an angle of internal friction of not less than 34 degrees as determined by the standard direct shear test - AASHTO T-236, utilizing a sample of the material compacted to 95 percent of AASHTO T-99 Methods C or D (with oversize correction as outlined in Note 7) at optimum moisture content.
3. The material shall be substantially free of shale or other soft or poor durability particles. The material shall exhibit magnesium sulfate soundness loss of less than 30 percent after four (4) cycles in accordance with AASHTO T-104.
4. Backfill not conforming to these specifications shall not be used without the written consent of RECO.
5. The Contractor shall provide the Owner's Engineer with a certificate of compliance certifying that the select granular backfill material complies with this section of the specifications. A copy of all test results performed by the contractor, which are necessary to assure compliance with the specification, shall also be furnished to the Owner's Engineer.
6. The frequency of sampling of select granular backfill, necessary to assure gradation control throughout construction, shall be as directed by the Owner's Engineer.

2.5.2 Embankment Fill Material

Embankment fill (Zone 3) used outside of the select granular backfill volume (Zones 1 and 2) shall exhibit an angle of internal friction of not less than 30 degrees. Embankment fill not conforming to this requirement shall not be used without the written consent of RECO.

PART 3 EXECUTION

3.1 GENERAL

The precast concrete arch structure shall be constructed in accordance with the lines, grades, details and dimensions shown on the drawings. The Contractor shall make use of the technical assistance provided by the supplier and provide adequate notice to the supplier of the date for start of arch erection.

3.2 PRECAST CONCRETE ARCH SEGMENT

3.2.1 Off-loading, handling, storage, and pre-assembly

When precast concrete arch segments (or elements) are off-loaded and stored, they shall be placed on edge upon secured dunnage on a level surface to avoid damage and warping, and to maintain cleanliness of the element prior to erection.

3.2.2 Erection of Precast Concrete Arch Segments:

1. Precast concrete segments shall be handled with a crane with a suitable capacity to safely handle the arch elements. TechSpan elements shall be lifted using inserts placed in the elements for that purpose.
2. Erect elements in sequence as shown on the drawings. When foundation is sloped, erection should begin at the low end of the structure and proceed in the up-slope direction.
3. Place segments tight against the front edge of the "recess" in the cast-in-place footing with the aid of wedging from the back of the segments. Longitudinally, joints between adjacent segments shall not exceed 3/4" (19 mm). The edge of the element on one side of the arch structure shall be placed to within 3/8" (10mm) from the centerline of the last element placed on the opposite side. Adjust element locations longitudinally to achieve consistent joint spacing.
4. Secure connecting wires between adjacent elements progressively as the placement of the arch segments advances. Place impermeable membrane over the joints using adhesive.
5. The final position of the installed arch segments shall clear both horizontally and vertically the span and height requirements of the tunnel.

### 3.3 GROUTING

Grout the TechSpan elements into the cast-in-place footing keyway recess after the arch is completely installed (on both sides) but prior to backfilling. Grout shall be cured in a manner sufficient to achieve specified strength.

### 3.4 CROWN BEAM

#### 3.4.1 Concrete for the Cast-in-Place Crown Beam

Concrete for the cast-in-place crown beam shall have a minimum 28 day compressive strength of 4,000 psi (27.6 MPa).

#### 3.4.2 Steel Reinforcing Bars

Steel reinforcing bars shall be ASTM A615, 60,000 psi (414 MPa) minimum yield strength.

#### 3.4.3 Cast-in-Place Crown Beam

The cast-in-place crown beam shall be formed to the dimensions shown in the drawings when granular backfill has reached the top of the assembled arch units.

#### 3.4.4 Styrofoam Spacers

Styrofoam spacers shall be incorporated into the crown beam as indicated by the drawings.

#### 3.4.5 Construction Joints

Construction joints in the cast-in-place crown beam shall be approved by the Engineer.

3.5 BACKFILL PLACEMENT

3.5.1 Commencing Backfilling

Do not commence backfilling until grouting of the footing keyway recess has been completed and cured as specified. In addition, backfill shall not proceed above the top of arch until casting of the crown beam has been completed and cured as specified.

3.5.2 Backfilling of TechSpan Structures

Backfilling of TechSpan structures must be performed in coordination with the erection and backfilling of the collar wall and wing walls as indicated on the drawings.

3.5.3 Placment of Backfill

Place approved backfill material in maximum 10"(250mm) compacted lifts unless otherwise specified. At no time during backfilling of the TechSpan structure should the differential level between opposite sides of the TechSpan structure exceed 20"(500mm).

3.5.4 Compaction Zones

TechSpan structures require three compaction zones, as shown on the drawings and described in the following table.

ZONE	RANGE LOCATION	COMPACTION	EQUIP. TYPE
1	0.0 - 1.5 ft (0 - 450mm) measured from backface of TechSpan element.	None	None
2	1.5 ft - 3.0 ft (450 - 900 mm) measured from back face of TechSpan element.	95% Standard Proctor per AASHTO T-99	Light walk behind compactor
3	> 3.0 ft (1000 mm) horizontally from backface of TechSpan element at footing.  > 3.0 ft (1000 mm) vertically above crown of TechSpan	95% Standard Proctor per AASHTO T-99	Large drum roller (with vibration)

3.5.5 Grading

At the end of each day, the backfill must be graded or sloped away from the back of the TechSpan segment to divert any run-off away from the work area.

3.5.6 Heavy equipment

Trucks and heavy equipment should not come closer than 5 ft (1500 mm) of the concrete TechSpan segments during any stage of backfilling, and must not traverse the longitudinal axis of the structure until a minimum of 3 ft (1000 mm) of fill has been placed above the arch crown. A further determination of maintained distances from the arch structure shall be made

by the Contractor and Owner's Engineer on the basis of the type of trucks or other narrow wheel-based equipment planned for use during backfill operations.

PART 4 (NOT USED)

-- End of Section --

## SECTION 04200

## MASONRY

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONCRETE INSTITUTE (ACI)

ACI SP-66 (1988) ACI Detailing Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1990a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153 (1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615 (1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 55 (1993a) Concrete Building Brick

ASTM C 90 (1993) Load-Bearing Concrete Masonry Units

ASTM C 91 (1993) Masonry Cement

ASTM C 270 (1992a) Mortar for Unit Masonry

ASTM C 476 (1991) Grout for Masonry

ASTM C 641 (1982; R 1991) Staining Materials in Lightweight Concrete Aggregates

ASTM C 780 (1991) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1072 (1993) Measurement of Masonry Flexural Bond Strength

ASTM D 2000 (1990) Rubber Products in Automotive Applications

ASTM D 2240 (1991) Rubber Property - Durometer Hardness

ASTM D 2287 (1992) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300SUBMITTAL PROCEDURES:

SD-01 Data

Concrete Brick; GA. Insulation; GA.

Manufacturer's descriptive data.

SD-04 Drawings

Masonry Work; GA.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-08 Statements

Cold Weather Installation; GA.

Cold weather construction procedures.

SD-09 Reports

Efflorescence Test; GA. Field Testing of Mortar; GA. Field Testing of Grout; GA. Prism tests; GA. Masonry Cement; GA. Fire-rated CMU; GA.

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

SD-13 Certificates

Concrete Masonry Units (CMU); FIO. Control Joint Keys; FIO. Anchors, Ties, and Bar Positioners; FIO. Expansion-Joint Materials; FIO. Joint Reinforcement; FIO. Reinforcing Steel Bars and Rods; FIO. Masonry Cement; FIO. Insulation; FIO. Precast Concrete Items; FIO.

Certificates of compliance stating that the materials meet the specified requirements.

Insulation; GA

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-14 Samples

Concrete Masonry Units (CMU); GA. Concrete Brick; GA.

Anchors, Ties, and Bar Positioners; GA.

Two of each type used.

Expansion-Joint Material; GA.

One piece of each type used.

Joint Reinforcement; GA.

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation; GA.

One piece of board type insulation, not less than 16 inches by 24 inches in size, containing the label indicating the rated permeance and R-values.

### 1.3 NOT USED

### 1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

#### 1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite. In addition, glass block units and prefaced concrete units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

#### 1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

#### 1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

### 2.2 NOT USED

### 2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Type I, Grade N. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

### 2.4 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, Normal weight. Cement shall have a low alkali content and be of one brand.

#### 2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

#### 2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

#### 2.10 MORTAR

Mortar shall be Type N in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Evaluation of performance shall be based on ASTM C 780 and ASTM C 1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the No. 8 sieve and 95 percent passing the No. 16 sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

#### 2.11 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.11.1 NOT USED

##### 2.11.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

#### 2.12 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be

zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

#### 2.12.1 Wire Mesh Ties

Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.

#### 2.12.2 NOT USED

#### 2.12.3 NOT USED

#### 2.12.4 NOT USED

#### 2.12.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

### 2.13 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153, class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

### 2.14 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615, Grade 60.

### 2.15 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

### 2.16 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920 JOINT SEALING.

## PART 3 EXECUTION

## 3.1 ENVIRONMENTAL REQUIREMENTS

## 3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

## 3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

## 3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.
- b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.
- c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.
- d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

## 3.1.2.2 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.
- b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

- d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

### 3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be free from chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

#### 3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

#### 3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

#### 3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 NOT USED

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises

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In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines

---

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines

---

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls

---

In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines

---

In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of columns and in thickness of walls

---

Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the

work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

### 3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

#### 3.2.7.1 NOT USED

#### 3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

### 3.2.8 Joint Widths

Joint widths shall be as follows:

#### 3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

#### 3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

#### 3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Tothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

#### 3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

#### 3.2.12 Partitions

Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be otherwise may be stopped

approximately 4 inches above the ceiling level. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement.

Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections of partitions.

3.3 NOT USED

3.4 NOT USED

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.10 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.10.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.10.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.11 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be

placed to provide not less than 5/8 inch cover to either face of the unit.

### 3.12 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

#### 3.12.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

#### 3.12.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

#### 3.12.3 Grout Holes and Cleanouts

##### 3.12.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

##### 3.12.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

#### 3.12.4 Grouting Equipment

##### 3.12.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping,

waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

#### 3.12.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

#### 3.12.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

##### 3.12.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

##### 3.12.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall

between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

- (1) The actual grout space or cell dimension must be larger than the sum of the following items:
  - a) The required minimum dimensions of total clear areas given in the table above;
  - b) The width of any mortar projections within the space;
  - c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.
- (3) For grouting spaces between masonry wythes.
- (4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.13 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.14 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using special control-joint units or sash jamb units with control joint key

in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07920 JOINT SEALING. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.15 NOT USED

3.15 NOT USED

3.16 LINTELS

3.16.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.17 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.18 NOT USED

3.19 NOT USED

3.20 NOT USED

3.21 NOT USED

3.22 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.22.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.23 NOT USED

## 3.24 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

-- End of Section --

## SECTION 05310

## STEEL DECKS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673 1989 (Errata 1990) Cold-Formed Steel Design Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446/A 446M 1991 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 525 1991 (Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A 611 1992 Steel, Sheet, Carbon, Cold-Rolled, Structural Quality

## FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 1993 Approval Guide

FM D/S1-28 1991 Insulated Steel Deck

## STEEL DECK INSTITUTE (SDEI)

SDEI DMCDFDRD 1992 (Number 28) Design Manual for Composite Decks, Form Decks and Roof Decks

SDEI MCSD 1992 Manual of Construction with Steel Deck

## UNDERWRITERS LABORATORIES INC. (UL)

UL BMD 1992 Building Materials Directory

UL 580 1988 (R 1989) Uplift Resistance of Roof Assemblies

## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## 1.2.1 SD-02, Manufacturer's Catalog Data

a. Accessories G A/E

## 1.2.2 SD-04, Drawings

a. Layout G A/E

#### 1.2.2.1 Layout Drawings

Show location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, and other pertinent details.

#### 1.2.3 SD-05, Design Data

##### a. Deck units G A/E

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

#### 1.2.4 SD-13, Certificates

##### a. Wind storm resistance G A/E

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Steel Deck

Deck and accessories shall be products of a manufacturer regularly engaged in manufacture of steel decking.

#### 1.3.2 Regulatory Requirements

##### 1.3.2.1 Fire Safety

Roof deck shall have been tested as a part of a roof deck construction assembly of the type used for this project, shall be listed as fire classified in the UL BMD, or listed as Class I construction in the FM P7825, and so labeled.

##### 1.3.2.2 Wind Storm Resistance

The roof construction assembly shall be capable of withstanding an uplift pressure of 300 kgs per square meter when tested in accordance with the uplift pressure test described in the FM D/S1-28 or as described in UL 580.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage the material or overload the decking during the construction period. The maximum uniform distributed storage load shall not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide for drainage. Maintain deck finish at all times to prevent the formation of rust. Replace damaged material.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than 1.0 mm before coating, meeting the requirements of AISI SG-673, except as modified herein.

#### 2.1.2 Steel Coating

ASTM A 525 designation G90 galvanized. Apply coating to both sides of

sheet.

## 2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

### 2.2.1 Adjusting Plates

Provide adjusting plates of same thickness and configuration as decking. Provide factory cut plates of predetermined size where possible.

### 2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 1.0 mm to close open ends at end walls, eaves, and openings through deck.

### 2.2.3 Cover Plates

Sheet metal. Polyethylene-coated, self-adhesive, 50 mm wide joint tape may be provided in lieu of cover plates on flat-surfaced decking.

### 2.2.4 Access Hole Covers

Sheet metal, minimum 1.2 mm thick.

### 2.2.5 Miscellaneous Accessories

Provide cant strips, fasteners, and other types of plates and closures as indicated or as necessary to complete the work. Provide accessories required for a finished installation.

## 2.3 FABRICATION

### 2.3.1 Deck Units

SDEI DMCDFDRD. Form decking and accessories from ASTM A 446/A 446M coated steel sheets, Grade A (231 MPa minimum yield strength); ASTM A 611 coated carbon steel sheets, Grade C, (231 MPa minimum yield strength). Provide deck units having the depth and the minimum structural properties indicated.

### 2.3.2 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured. Provide shop primer compatible with field applied finish painting, as specified in Section 09900, "Paints and Coatings."

## PART 3 EXECUTION

### 3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

### 3.2 INSTALLATION

Install steel deck units in accordance with approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before

permanently anchoring deck units. Locate deck ends over supports only. Lap roof deck a minimum of 50 mm. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated.

### 3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units with screws and to adjacent deck units with Tec Screws. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing fastening. Anchoring the deck to structural supports with welds is prohibited. Attachment of adjacent deck units by button-punching is prohibited.

### 3.2.2 Openings

Reinforce deck or frame openings through deck as necessary for rigidity and load carrying capacity. Cut or drill holes or other openings required for work of other trades. Deck manufacturer shall approve holes or openings larger than 6 inches in diameter prior to drilling or cutting. Openings shall not interfere with seismic members such as chords and drag struts.

### 3.2.3 Deck Damage

SDEI MCSD, for repair of deck damage.

### 3.2.4 Accessory Installation

#### 3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

#### 3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

## 3.3 FIELD QUALITY CONTROL

### 3.3.1 Flatness

Inspect the decking top surface for flatness after installation. Verify flatness by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1.6 mm; when gap is more than 1.6 mm, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

## SECTION 05315

## BLAST AND FRAGMENT RESISTANT WALLS

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446	(1987) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 548	(1982) Steel Wire, Carbon, Cold-Heading Quality, for Tapping or Sheet Metal Screws
ASTM A 615	(1989) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement Textile

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01300 SUBMITTALS:

SD-04, Drawings

BFR Wall Layout and Details; GA

Detail drawings shall include dimensions, required type, number, and length of all BFR steel panels, panel connection details, details at wall corners, and details for fabrication of all steel panels. Drawings shall include overall plan layouts and elevations of walls sufficient to show final panel arrangements. Drawings shall also include number, size, type, dimensions and locations of all additional reinforcing steel bars in the walls.

SD-13, Certificates

Steel Panels; FIO

Certificates of compliance stating that all steel facing panels, lacing panels, and miscellaneous steel components of the BFR walls conform to the requirements specified.

SD-20, Construction Methods and Procedures

BFR Wall System; FIO.

Technical description of the materials, equipment, methods, procedures, and construction sequence to be used in constructing the BRF walls, Procedures shall generally conform to those provided by the patent holder.

#### 1.4 STORAGE

BFR steel panels shall be stored on wooden bearers out of contact with the ground with a slope of 1:100 along the sheet length to prevent accumulation of water. The steel panels shall be covered with a waterproof cover to prevent exposure to water but allow air circulation.

### PART 2 PRODUCTS

#### 2.1 BLAST AND FRAGMENT RESISTANT (BFR) WALLS

The headwall, side and rear walls of this magazine shall be walls made from the Blast and Fragment Resistant (BFR) wall system. The BFR system is protected by United States Patent Number 4,433,522 and other patents. Walls shown on the drawings as 12 inches thick shall be made of the 300 millimeter thick BFR wall section. Walls shown on the drawings as 10 inches thick shall be made of the 250 millimeter thick BFR wall section.

#### 2.2 STEEL PANELS

Steel facing panels, lacing panels, half panels, and other miscellaneous panels for the BFR walls shall conform to ASTM A 446, Grade B, coating designation G90, non-oiled. Dimensions, gage, and corrugation pattern of these panels shall conform to the requirements of the BFR system as defined by the patent holder.

#### 2.3 CONCRETE

Concrete for infill in the BFR walls shall conform to Section 03300, CONCRETE FOR BUILDING CONSTRUCTION.

#### 2.4 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A 615, Grade 60.

#### 2.5 STEEL SHEET METAL SCREWS

Steel sheet metal screws shall be the self-tapping type, galvanized conforming to ASTM A 548.

### PART 3 EXECUTION

#### 3.1 GENERAL

BFR walls shall be constructed according to the methods and procedures generally outlined by the manufacturer and provided in the submittals.

#### 3.2 WORKMANSHIP

Workmanship and manufacturing tolerances of the BFR steel elements shall be such as to insure proper fit when assembled and interchangeability of elements of the same type and size. Panels shall be well formed to shape and size, with sharp lines and true curves. Panels with warped or buckled edges shall not be used in wall construction and shall be removed from the job site.

#### 3.3 PREPARATION OF MATERIALS

Before erection, all BFR steel elements shall be inspected and cleaned of all loose scale, rust, and other deleterious material. Any damage to the galvanized coating shall be repaired using a zinc-rich paint.

3.4 ERECTION OF STEEL PANELS

Erection of steel BFR panels shall not begin until foundations have been completed. Steel panels shall be erected in accordance with the manufacturer's recommended procedure. Steel panels shall be erected plumb and true to lines indicated on the drawings and in conformance with the tolerances listed in Table 1. Joints between steel panels shall be connected with no fewer than two steel sheet metal screws at each end and shall be mortar tight.

3.5 TEMPORARY BRACING

Temporary bracing shall be provided to prevent misalignment and damage to the erected BFR steel panels during construction and bulging and separating of the steel panels during concrete placement. Care shall be taken to prevent the bracing from damaging the galvanized coating on the steel panels. Bracing shall remain in place until the walls are strong enough to carry their own weight and any other construction or natural loads, but not before 24 hours has elapsed since concrete placement. Construction of the roof slab shall not be started until the walls are sufficiently strong to support the roof. In no case shall bracing be removed before the concrete strength has reached 70 percent of design strength as determined by field cured cylinders or other methods.

3.6 PLACING CONCRETE

Concrete shall be placed successively in lifts not exceeding 24 inches, and each lift shall be allowed to partially set before pouring the next lift. Concrete may be placed using buckets or chutes or by pumping. If concrete pumping is used, the rate of pumping shall not exceed 7-1/2 cubic yards per hour. The work shall be visually inspected during the placement of each lift to ensure that all spaces between the steel panels are completely filled with concrete.

3.7 CONSOLIDATION

Immediately after placing, each layer of concrete shall be consolidated. Consolidation shall be by placing manual vibration bars on the outside of walls or by tapping with a rubber mallet. Internal vibrators shall not be used for consolidation of concrete in BFR walls. The use of form vibrators must be specifically approved.

3.8 CONSTRUCTION JOINTS

Vertical construction joints shall be made using the manufacturer's recommended method. Vertical joints shall be located not less than 6 feet from wall corners. BFR steel facing panels shall be continuous across vertical construction joints. Horizontal construction joints shall not be permitted.

TOLERANCES FOR BFR WALLS

1.	Variations from the plumb	In any 10 feet of length ---- 1/4 inch Maximum for entire length --- 1 inch
2.	Variation from the level	In any 10 feet of length ---- 1/4 inch Maximum for entire length --- 3/4 inch
3.	Variation of the linear	In any 20 feet ----- 1/2 inch

building lines from established position in plan	Maximum -----	1 inch
4. Variation of distance between walls		1/4 inch per 10 feet of distance, but not more than 1 inch total variation
5. Variation in the sizes and locations of wall openings	Minus -----	1/4 inch
	Plus -----	1/2 inch
6. Variation in the thickness of walls	Minus -----	1/2 inch
	Plus -----	1/2 inch

-- End of Section --

## SECTION 05500

## MISCELLANEOUS METAL

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335 (1989) Specification of Structural Steel Buildings - Allowable Stress Design, Plastic Design

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1989) Structural Steel

ASTM A 53 (1989a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 325 (1986a) High-Strength Bolts for Structural Steel Joints

ASTM A 446 (1989) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 500 (1989) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 525 (1987) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1988) Structural Welding Code - Steel

## MILITARY SPECIFICATIONS (MS)

MIL-H-29181 (18 Aug 1978; Rev 21 Dec 1987) Hasp, High Security, Shrouded, for High and Medium Security Padlock

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## SD-02 Manufacturer's Catalog Data

Extruded rubber fenders.

## SD-04 Drawings

Miscellaneous Metal Items; GA.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings shall be submitted for the following items: Doors and Door Frames; Door Operators and Hardware; Louvers and Louver Fragment Shields; Ventilator; and Weatherstripping.

## SD-13 Certificates

Extruded rubber fender.

## 1.4 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 446, or ASTM A 525, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

## 1.5 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

## 1.6 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

## 1.7 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or

indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete.

## PART 2 PRODUCTS

### 2.1 STRUCTURAL STEEL

Structural steel shapes and plates shall conform to ASTM A 36 unless otherwise noted or specified.

### 2.2 BOLTS

Unless otherwise noted, structural steel bolts, including nuts and washers, shall conform to ASTM A 325.

### 2.3 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

### 2.4 MAGAZINE LOUVER GUARDS

Louver guards shall be 1/2-inch round bars, spaced not over 8 inches on center horizontally. Bars shall be securely welded to the angle frame. Guards and fasteners shall be galvanized.

### 2.5 NOT USED

### 2.6 NOT USED

### 2.7 MAGAZINE LOUVERS

Louvers shall be galvanized steel and the standard product of a manufacturer regularly engaged in the manufacture of louvers of the type shown, and the louvers provided shall essentially duplicate louvers that have been in successful operation for a period of at least 5 years. Louvers shall not be removable from the outside of the structure. Louvers shall be provided with 140 degrees F fusible link fire damper mechanism, equipped with suitable spring closing device, and 16 mesh insect screens. Blades shall be accurately fitted and edges of louver blades shall be folded or beaded for rigidity.

### 2.8 MAGAZINE VENTILATORS

Ventilators shall be of the stationary type, constructed of galvanized ferrous metal sheets, and shall be furnished complete, including insect screens. The ventilators shall be designed to withstand stresses developed by winds up to and including 125 miles per hour, shall be waterproof and stormproof under all operating conditions, and shall be free from backdraft. The design shall be such that the ventilators will be capable of self-cleaning by the action of the elements, with provision for carrying water and normal, wind-transported soil matter to the outside. Ventilators shall be adequately reinforced and will braced, with joints properly formed. Reinforcing members, braces, bolts, and rivets shall be of galvanized ferrous metal of sufficient size to assure rigid and sturdy construction, shall be properly applied and installed in such manner as to avoid corrosion, and shall be secured in an approved manner.

## 2.9 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

## 2.10 STEEL DOOR FRAMES

Steel door frames shall be made of structural steel conforming to ASTM A 36. Steel door frames shall be neatly mitered and securely welded at the corners with all welds ground smooth. Provision shall be made to stiffen the top member for all spans over 3 feet.

## 2.11 HIGH SECURITY HASPS

High security hasps shall conform to MIL-H-29181, Style NAPEC and 0957-2. High security hasps are Government-furnished, Contractor-installed items.

## 2.12 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

## 2.12 "D" SHAPE TYPE RUBBER FENDER

Impact type bumper cushions shall be extruded from EPDM rubber meeting or exceeding the following specifications:

Tensile Strength	200 PSI
Elongation	300 Percent
Hardness	70 plus or minus 5
Tear Strength	
(ASTM D 624)	225 lbs/in
Brittleness	Minus 64 degrees (no failure)
Ozone Resistance	
(ASTM D 1171)	Exposure method A or B.
Impact Resistance	
(ASTM D 2632)	Absorbs 75 percent of force
Deflection at 60,000 Ft. lbs.	3 inches with no ruptures

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Item listed below require additional procedures as specified.

### 3.2 PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in SECTION 03300 CONCRETE FOR BUILDING CONSTRUCTION.

-- End of Section --

## SECTION 05510

## COLD FORMED STEEL TRUSSES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 525	(1993) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM C 955	Standard Specification for Load Bearing (Transverse and Axial) Steel Studs, Runner (Track) and Bracing and Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases
ASTM C 1007	Standard Specification for the Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories

## AMERICAN IRON AND STEEL INSTITUTE PUBLICATION (AISI)

AISI Design Manual	Specification for the Design of Cold-Formed Steel Structural Members, 1980 Revision
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## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Cold Formed Steel Trusses; FIO

Manufacturer's descriptive data and technical literature.

Design Analysis; GA

Design analysis as one package with the drawings.

SD-04 Drawings

Cold Formed Steel Trusses; GA.

Detail drawings indicating truss member thickness, type, grade, and class; fastener type and quantity dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data, installation instructions, design and erection drawings.

#### SD-13 Certificates

Cold Formed Steel Trusses; FIO

Submit statements from the framing manufacturer certifying conformance with ASTM C 955.

### 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before installation. Trusses shall be hot-dip galvanized in accordance with ASTM A 525. Exposed fastenings shall be of compatible materials. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Products and installation shall, as a minimum, conform to ASTM C 955 and ASTM C 1007 and to the AISI Design Manual

### 1.4 DESIGN REQUIREMENTS

Criteria, loading combinations, and definitions shall be in accordance with ASCE 7.

#### 1.4.1 Dead Loads

The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.

#### 1.4.2 Collateral Loads

Collateral load of 5 pounds per square foot shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be shown on the shop (detail) drawings and the structure shall be strengthened as required. The Contractor is responsible for providing the truss manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds before design of the building commences.

#### 1.4.3 Roof Live Loads

##### 1.4.3.1 Uniform Loads

A uniform roof live load of 20 psf, including maintenance traffic and construction loads, shall be applied in accordance with ASCE 7.

##### 1.4.3.2 Concentrated Loads

In addition to roof live loads, a minimum design concentrated load of 300 pounds shall be used to simulate a construction load on roof panels.

#### 1.4.4 Roof Snow Loads

The design roof snow loads, including effects of drifting, shall be determined based on the ground snow load shown on the drawings.

#### 1.4.5 Wind Loads

Wind uplift pressures are shown on the drawings.

#### 1.4.6 Seismic Loads

Seismic loads shall be computed for seismic zone 1 in accordance with ASCE 7 using an importance factor of 1.

### 1.5 DESIGN ANALYSIS

The design analysis shall be the design of a licensed Professional Engineer experienced in design of this work and shall include complete calculations for the trusses and required anchorage. All vertical and lateral forces shall be calculated and summarized. Formulas and references shall be identified. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design.

### 1.6 WORKMANSHIP

Cold formed steel trusses shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed welds shall be ground smooth. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 1.7 ANCHORAGE

Anchorage shall be provided where necessary for fastening joists securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

### 1.8 DEFLECTIONS

Maximum deflections under applied load combinations (including live load, snow or wind loads) shall not exceed 1/180th of the span length. The calculated deflection from the concentrated load shall not exceed 1/180th of the span length.

## PART 2 PRODUCTS

### 2.1 COLD FORMED STEEL

Steel trusses, bridging, and all associated framing components shall be constructed from cold formed steel conforming to the minimum requirements of ASTM A 446, Grade D, possessing a minimum yield of 50,000 psi.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations.

### 3.2 CONNECTIONS

#### 3.2.1 Welds

Welds shall be of the type, size and location shown (in the contract documents or approved shop drawings).

Welded connections shall be performed in accordance with the American Welding Society (AWS) Specification for Welding Sheet Steel in Structures, D1.3.

Consult applicable AWS specifications for information regarding safe welding procedures.

Welds shall be cleaned and coated with rust inhibitive galvanizing paint.

#### 3.2.2 Screws

Screws shall be of the type, size, and location shown (in the contract documents or approved shop drawings);

Screw penetration through jointed materials shall not be less than three exposed screw threads.

### 3.3 INSTALLATION, GENERAL

Prefabricated trusses shall be square, with components attached in a manner to prevent racking during fabrication, transportation and lifting. Provisions to lift the panel shall be included in the frame's design and construction.

Field cutting of steel framing members shall be by saw or shear. Torch cutting will not be permitted except, by written approval of the Engineer or Record.

Temporary bracing shall be provided and remain in place until work is permanently stabilized.

Splicing of framing components is not permitted.

Provide web stiffeners at all end support locations.

Mechanical bridging shall be installed before loading.

End blocking shall be provided where truss ends are not restrained against rotation.

Provide additional framing around openings when the width of the opening exceeds the typical truss spacing.

-- End of Section --

## SECTION 06100

## ROUGH CARPENTRY

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111 (1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307 (1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus

ASTM C 591 (1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C 665 (1995) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C 1289 (1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM E 84 (1996a) Surface Burning Characteristics of Building Materials

ASTM E 96 (1995) Water Vapor Transmission of Materials

ASTM E 154 (1988; R 1993) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

ASTM F 547 (1977; R 1990) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2 (1995) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

AWPA C9 (1995) Plywood - Preservative Treatment by Pressure Processes

AWPA M4	(1995) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(1996) Standards for Waterborne Preservatives
APA - THE ENGINEERED WOOD ASSOCIATION (APA)	
APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
CALIFORNIA REDWOOD ASSOCIATION (CRA)	
CRA-01	(1997) Standard Specifications for Grades of California Redwood Lumber
FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)	
FM LPD 1-49	(1995) Loss Prevention Data Sheet - Perimeter Flashing
NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)	
NHLA-01	(1994) Rules for the Measurement & Inspection of Hardwood & Cypress
NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)	
NELMA-01	(1997) Standard Grading Rules for Northeastern Lumber
SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)	
SCMA-01	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress
SOUTHERN PINE INSPECTION BUREAU (SPIB)	
SPIB 1003	(1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber
WEST COAST LUMBER INSPECTION BUREAU (WCLIB)	
WCLIB Std 17	(1996; Supples VII(A-E), VIII(A-C)) Grading Rules for West Coast Lumber
WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)	
WWPA-01	(1995; Supple Nos. 1 thru 5) Western Lumber Grading Rules 95

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Grading and Marking; Pressure Preservative Treated Dimensional Lumber and Plywood.

Manufacturer's certificates (approved by an American Lumber Standards

approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

### 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

## PART 2 PRODUCTS

### 2.1 LUMBER AND SHEATHING

#### 2.1.1 Grading and Marking

##### 2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

##### 2.1.1.2 NOT USED

##### 2.1.1.3 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

##### 2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

##### 2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWP A M4. The following items shall be treated:

- a. Wood members in contact with or within 18 inches of soil.
- b. Wood members in contact with water.
- c. Wood members exposed to the weather including those used in roofing systems or as nailing strips or nailers.
- d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

##### 2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 4 inches or less, nominal thickness, 19 percent maximum. 5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.

b. Roof Planking: 15 percent maximum.

c. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 NOT USED

2.1.10 NOT USED

2.1.11 NOT USED

2.1.12 Miscellaneous Wood Members

2.1.12.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Furring	1 x 3.
Nailing strips	2 inch stock.

2.1.12.2 Wood Bumpers

Bumpers shall be of the species and grade in accordance with TABLE II at the end of this section, size as shown.

### 2.1.12.3 Sill Plates

Sill plates shall be standard or number 2 grade.

### 2.1.12.4 Blocking

Blocking shall be standard or number 2 grade.

### 2.1.12.5 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

## 2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

### 2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

### 2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

### 2.2.3 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

### 2.2.4 Expansion Shields

Type and size best suited for intended use.

### 2.2.5 NOT USED

### 2.2.6 NOT USED

### 2.2.7 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T01. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

## 2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown.

R-values shall be determined at 75 degrees F in accordance with ASTM C 518.

Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher

recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

#### 2.3.1 Batt or Blanket

##### 2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation, Class A, having a UL rating of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84. Width and length shall suit construction conditions.

##### 2.3.2 NOT USED

##### 2.3.3 NOT USED

#### 2.3.4 Rigid Insulation

##### 2.3.4.1 NOT USED

##### 2.3.4.2 Polyurethane or Polyisocyanurate Board

Polyurethane or polyisocyanurate board shall have a minimum recovered material content of 9 percent by weight of core material in the polyurethane or polyisocyanurate portion. Unfaced preformed polyurethane shall conform to ASTM C 591. Faced polyisocyanurate shall conform to ASTM C 1289.

#### 2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 0.5 perms as determined in accordance with ASTM E 96, unless otherwise specified.

### PART 3 EXECUTION

#### 3.1 NOT USED

#### 3.2 NOT USED

#### 3.3 NOT USED

#### 3.4 NOT USED

#### 3.5 NOT USED

#### 3.6 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

##### 3.6.1 NOT USED

##### 3.6.2 NOT USED

##### 3.6.3 Blocking

Blocking shall be provided as necessary for application of wallboard, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 8 feet for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

##### 3.6.4 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

### 3.6.5 NOT USED

### 3.6.6 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 16 inches on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

### 3.6.7 Rough Bucks and Frames

Rough bucks shall be set straight, true, and plumb, and secured with anchors near top and bottom of each wood member and at intermediate intervals of not more than 3 feet. Anchors for concrete shall be expansion bolts, and anchors for masonry shall be 3/16 x 1-1/4 inch steel straps extending not less than 8 inches into the masonry and turned down 2 inches into the masonry.

### 3.6.8 Wood Bumpers

Wood bumpers shall be bored, countersunk and securely bolted in place.

### 3.6.9 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.

### 3.7 NOT USED

### 3.8 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

### 3.9 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied to provide a continuous barrier at window and door frames, and at all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations. Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

### 3.10 NOT USED

TABLE I. SPECIES AND GRADE

Subflooring, Roof Sheathing, Wall Sheathing, Furring

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA-01	Cypress			X	
NELMA-01	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock-Tamarack				X
CRA-01	Redwood		X		
SCMA-01	Cypress			X	
SPIB 1003	Southern Pine		X		
WCLIB Std 17	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA-01	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
NHLA-01	Red Oak	X	
NELMA-01	Northern Pine		X
	Eastern Hemlock-Tamarack		X
SPIB 1003	Southern Pine	X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
WCLIB Std 17	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA-01	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X

-- End of Section --

## SECTION 07110

## BITUMINOUS DAMPPROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4479	(1993) Asphalt Roof Coatings - Asbestos Free

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-13 Certificates

Materials; Asphaltic Primer Fibrated, Solvent-Based Asphalt Dampproofing; .  
Certificates attesting that the materials meet the requirements specified.

## 1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous dampproofing work specified to meet the requirements of the contract.

## 1.4 DELIVERY, STORAGE AND HANDLING

Dampproofing materials shall be delivered to the project site in the original sealed containers bearing the name of manufacturer, contents and brand name, and stored in a weathertight enclosure to prevent moisture damage and absorption. Dampproofing materials shall be protected from freezing. Asphalt shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup; and therefore, shall not be used to cover dampproofing materials. Care shall be taken during storage to avoid separation or settlement of the emulsion components. Damaged or deteriorated materials shall be removed from the project site.

## PART 2 PRODUCTS

## 2.1 NOT USED

## 2.2 SOLVENT-BASED ASPHALT DAMPPROOFING

## 2.2.1 Asphaltic Primer

Primer for cold-applied solvent-based asphalt dampproofing shall conform to

ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

### 2.2.2 Fibrated Asphalt

Fibrated solvent-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 4479 Type I, asbestos-free, manufactured with selected asphalts, stabilizers, mineral spirits and fibrated with mineral fibers. Solvent-based asphalt shall contain 72 percent solids by weight, 65 percent solids by volume.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous dampproofing shall be prepared in accordance with dampproofing manufacturer's recommendations. Surface preparation shall be approved prior to dampproofing application.

#### 3.1.1 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

#### 3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

#### 3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage the dampproofing materials and impair performance shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar.

#### 3.1.4 Metal Surfaces

Metal surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

### 3.2 APPLICATION OF BITUMINOUS DAMPPROOFING

#### 3.2.1 NOT USED

#### 3.2.2 Solvent-Based Asphalt

Solvent-based asphalt dampproofing work shall not be performed in temperatures below 40 degrees F. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film not less than 12 mils thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

- a. Primer: 1/2 gallon per 200 square feet, cold-applied.
- b. Dampproofing Coat: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

### 3.3 CLEAN-UP

Surfaces of other work which are stained with dampproofing materials shall be cleaned with a cleaner recommended by dampproofing manufacturer.

3.4 PROTECTION

The completed dampproofing work shall be protected from damage during and after construction.

-- End of Section --

## SECTION 07111

## ELASTOMERIC MEMBRANE WATERPROOFING

## PART 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	(1981) Rubber Products
ASTM D 412	(1987) Rubber Properties in Tension
ASTM D 471	(1979) Rubber Property - Effect of Liquids
ASTM D 624	(1986) Rubber Property - Tear Resistance
ASTM D 1004	(1966, R 1988) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 4637	(1987) Vulcanized Rubber Sheet Used in Single-Ply Roof Membrane
ASTM E 96	(1990) Water Vapor Transmission of Materials
ASTM E 154	(1988) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM G 21	(1970, R 1985) Determining Resistance of Synthetic Polymeric Materials to Fungi

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## SD-04 Drawings

Waterproofing System; GA.

Detail drawings showing size of sheets, position of sheets and splices, flashing and termination details, and expansion joint details.

## SD-06 Instructions

Installation; GA.

Manufacturer's instructions for installation of the elastomeric membrane, including procedures for preparing the membrane for use, flashing, and splicing. Instructions shall include recommended or required protective

covering and procedures for safe handling and use of cleaners, adhesives, and sealants.

SD-13 Certificates

Materials; GA.

Certificates of compliance attesting that the materials meet specification requirements. Certificates may show qualification of the identical compound in the specified test.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered to the job site in unopened containers bearing the manufacturer's name, brand name, and description of contents. Membrane, flashing, and adhesives shall be stored in clean, dry areas. Storage temperature for adhesives shall be between 60 and 80 degrees F. Protection board shall be stored flat and off the ground.

PART 2 PRODUCTS

2.1 MATERIALS

All adhesives, mastics, cements, tapes, and primers shall be as recommended by the membrane manufacturer and shall be compatible with the materials to which they are to be bonded.

2.1.1 Performance Requirements

All membranes shall meet the following requirements when tested by the referenced ASTM standards:

Puncture Resistance (ASTM E 154)	40 pounds, minimum
Water Vapor Transmission at 80 degrees F Permeance (ASTM E 96, Procedure B)	0.25 perms (max.)
Resistance to Soil Bacteria or Fungi (ASTM G 21 or ASTM E 154)	No sustained growth or discoloration after 21 days

2.1.1.1 Butyl Rubber

Thickness, plus or minus 10 percent	60 mils
Specific Gravity (ASTM D 297)	1.2 plus or minus 0.05
Tensile Strength (ASTM D 412)	1200 psi (min.)
Elongation (ASTM D 624)	300 percent (min.)
Tear Resistance (ASTM D 624)	125 lb./inch (min.)
Water Absorption (ASTM D 471) 158 degrees F, 168 hours	plus 2 percent (max.)

2.1.1.2 Plastic Elastomeric Sheeting

Membrane shall be a minimum of 56 mils thick and shall meet the following requirements:

Tensile Strength (ASTM D 412, Die C)	220 psi (min)
Elongation (ASTM D 412, Die C)	250 percent (min.)
Tear Resistance (ASTM D 1004)	350 lb./inch (min.)

#### 2.1.1.3 Composite Self-Adhering Membrane

Membrane shall be a polymeric sheeting integrally bonded to rubberized asphalt with a minimum thickness of 60 mils.

#### 2.1.1.4 Chlorinated Polyethylene (CPE) Sheeting

Membrane shall be uncured chlorinated polyethylene, synthetic elastomeric sheeting of 40 mils nominal thickness.

#### 2.1.1.5 Chloroprene

Chloroprene membrane shall conform to ASTM D 4637, Type II, Grade 1, Class U, 60 mils minimum thickness.

#### 2.1.1.6 Ethylene Propylene Diene Monomer (EPDM) Membrane

EPDM membrane shall conform to ASTM D 4637, Type I, Grade I, Class U, 60 mils minimum thickness.

#### 2.1.2 Protection Board

Protection board for waterproofing membrane shall be 1/2-inch minimum asphalt plank, 1/2-inch fiberboard or premolded bituminous protection board; 1/8-inch thick for vertical surfaces, and 1/4-inch thick for horizontal surfaces. The membrane and protection board must be compatible.

#### 2.2 ACCESSORIES

Flashing, counterflashing, expansion joint covers and corner fillets shall be as recommended by the membrane manufacturer.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Surfaces to which waterproofing is to be applied shall be clean, smooth, and free from deleterious materials and projections. Holes, honeycomb, cracks, or cavities shall be pointed or filled and finished flush with portland cement mortar. Top surfaces of projecting metal or concrete ledges below grade, except footings, shall be beveled. Before waterproofing is applied, the surfaces to be covered shall be swept or brushed carefully to remove all dust and foreign matter. Concrete surfaces to receive elastomeric waterproofing will not be cured with compounds containing wax or oil.

#### 3.2 APPLICATION

Waterproofing shall not be applied to wet surfaces. The ambient and surface temperatures shall be above 40 degrees F during application. Membrane under slabs shall be carried up abutting vertical surfaces to the level of finish of floor or to within 1/2 inch of the top edge of base where base is shown and cemented solid to the substrate. Membrane shall not be continuous through walls, floors, piers, and columns unless otherwise shown. Concrete surfaces shall be primed to receive the membrane. Membranes shall be handled and installed in accordance with the approved installation

instructions. All primers, adhesives, and mastics shall be applied in accordance with the membrane manufacturer's printed instructions. Laps shall be oriented so that water will flow over the lap, and not into them. As soon as the mastic is fully set and dry, joints shall be checked. Where any openings or fishmouths appear, joints shall be resealed and rerolled. Wrinkles and buckles shall be avoided in applying membrane and joint reinforcement. Nonadhering membranes shall be unrolled and allowed to remain flat for at least 2 hours before application. Membranes shall be drawn tight during installation without stretching. Self-adhering membrane shall be installed by removing the release sheets on the back of the membrane and applying the tacky surface onto the primed surface. Laps and splices shall be sealed prior to completion of a day's work.

### 3.2.1 Butyl Rubber

Each sheet shall be lapped at sides and ends a minimum of 6 inches over the preceding sheet. Lap and splice areas of membrane shall be cleaned with heptane, hexane, or white gasoline. Six-inch-wide unvulcanized compounded butyl tape shall be applied between lapped splices so that the tape extends approximately 1/4 inch beyond the exposed sheeting edge. The tape shall be rolled firmly into place as it is applied. Tape backing shall be removed and the lapped sheeting rolled or pressed into place. Splicing adhesive shall be applied to the lapped area 3-1/2 inches on either side of the lapped edge. The splice adhesive shall be allowed to dry thoroughly and the lap reinforced with 6-inch-wide unvulcanized compounded butyl tape. Full contact shall be made for all lap areas. Corner splices and flashing overlaps shall be reinforced with a 12-inch-wide strip of membrane over one layer of butyl tape or with a prefabricated corner of butyl rubber.

### 3.2.2 Plastic Elastomeric Sheeting

Sheeting shall be applied in sections no longer than 18 feet. Each sheeting shall be lapped at sides and ends a minimum of 6 inches over the preceding sheet. Lap splices shall be reinforced with 12-inch-wide strips of plastic sheeting or as recommended in the approved installation instructions. Lap and splices shall be sealed in a full bed of adhesive at the rate recommended by the manufacturer of the material. Sheeting and joint strips shall be rolled with a 50 to 100 pound roller on horizontal surfaces, and a 6-inch rubber hand roller on vertical surfaces.

### 3.2.3 Composite Self-Adhering Membrane

On vertical surfaces, membrane shall be applied in lengths up to 8 feet starting at the bottom. Each sheet shall be lapped at edges and ends a minimum of 2-1/2 inches over the preceding sheets. The membrane shall be rolled to adhere with the substrate. Corners and joints shall be double-covered by first applying a 12-inch width of membrane centered along the corner joint. Inside and outside corners shall then be covered with membrane. Exposed termination edges of membrane on horizontal or vertical surfaces shall be finished with a troweled bead of mastic. Mastic shall be applied around termination edges of membrane and around drains and projections. Mastic shall be applied at the termination of each day's work.

### 3.2.4 Chlorinated Polyethylene (CPE) Sheeting

Sheets shall be lapped at edges and ends a minimum of 2-1/2 inches over the preceding sheet. All horizontal membranes shall overlap vertical surfaces by at least 3 inches.

### 3.2.5 Chloroprene Rubber Sheeting

Each sheet shall overlap the previously installed sheet by a minimum of 3 inches. Sheet shall be folded lengthwise to expose one half of the underside of the sheet for cleaning the sheet with cleaner recommended by the manufacturer. Adhesive shall be applied to sheet and substrate. Two coats of adhesive are required on the substrate with 1/2-hour between coats. Sheet shall not be bonded to substrate until adhesive does not come off at a dry finger touch. Chalk lines or masking tape shall be used as guides for adhesive application and positioning sheets. After adhesive has dried, sheet shall be folded back onto the substrate or previously applied sheet membrane. Membrane shall be rolled to obtain complete adhesion. The exposed edge of each sheet shall be further sealed with a fillet-shaped bead of adhesive, tooled to obtain positive contact with the surface of both sheets.

### 3.3 TESTS

When required, and after the system is cured, the membranes on horizontal surfaces shall be tested by flooding the entire waterproofed area with a minimum of 2 inches head of water for a period of 24 hours. There shall be no water added after the start of the period. Measure water level at the beginning and at the end of the 24-hour period. If the water level falls, remove the water and inspect the waterproofing membrane. Leak sites shall be marked, dried and repaired, and the test shall be repeated.

### 3.4 PROTECTION

Horizontal applications of membrane shall be protected from traffic during installation. No equipment shall be allowed directly on the membrane. Plywood, or similar material, overlayment shall be provided for wheel-ways. Walkways shall be provided where heavy traffic from other trades is expected. Materials shall not be stored on the membrane. A protective covering shall be installed over the membrane immediately after installation or testing. If membrane is to be exposed, a temporary covering shall be applied to protect the membrane until the protection board is installed.

#### 3.4.1 Projections

Projections passing through membrane shall be flashed as recommended by the manufacturer of the waterproofing membrane.

#### 3.4.2 Counterflashing

Waterproofing connecting with work exposed to the weather shall be counterflashed to form a water-tight connection. Upper edge of membrane waterproofing and protective covering shall be counterflashed.

#### 3.4.3 Expansion Joints and Fillets

Expansion joints and corner fillets shall be installed as recommended by the manufacturer of the waterproofing membrane.

#### 3.4.4 Vertical Membrane Waterproofing

Waterproofing shall be protected with a 1/2-inch minimum fiberboard, 1/2-inch asphalt-impregnated fiberboard or 1/8-inch compatible water-resistant (bitumen type) protection board. Edges of protection shall be butted, and exposed surfaces shall be covered by a coating of bitumen.

3.4.5 Horizontal Membrane Waterproofing

Waterproofing shall be covered with portland cement mortar not less than 3/4 inch thick, uniformly placed and allowed to set before subsequent construction is installed.

-- End of Section --

## SECTION 07412

## NON-STRUCTURAL METAL ROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1996a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1997) Steel Sheet, 5% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 1289	(1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1994) Specular Gloss
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995a) Measuring Adhesion by Tape Test
ASTM D 4214	(1997) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies
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## 1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies the specified design and additional requirements contained herein. The roofing system shall be provided by the Contractor as a complete system, as tested and approved in accordance with UL 580. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

### 1.2.1 Non-Structural Metal Roof System

This section applies to the roof for the Operations Building and the Pumphouse only. The Non-Structural Metal Roof System covered under this specification shall include the entire roofing system; the metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts, eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the system.

### 1.2.2 Manufacturer

The non-structural metal roofing system shall be the product of a manufacturer who has been in the practice of manufacturing metal roofs for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

### 1.2.3 Installer

The installer shall be certified by the metal roof manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

## 1.3 DESIGN LOADS

Wind uplift pressures are shown on the contract drawings. Non-structural

Metal Roof System assemblies shall be approved to resist wind uplift pressures of Class 90 as defined in UL 580.

#### 1.4 PERFORMANCE REQUIREMENTS

The metal roofing system supplied shall conform to the roof slope, the underlayment, and uplift pressures shown on the contract drawings. The Contractor shall furnish a commercially available roofing system which satisfies all the specified requirements.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Metal Roofing; GA.

a. Drawings consisting of catalog cuts, flashing details, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be provided by the metal roofing manufacturer.

b. Drawings showing the UL 580, Class 90 tested roof system assembly.

##### SD-13 Certificates

Roof Panels; GA. Installation; GA. Accessories; GA.

Certificates attesting that the panels and accessories conform to the specified requirements. Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least 3 representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.

Insulation; GA.

Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Installer; GA.

Certification of installer.

Warranties; GA.

At the completion of the project, signed copies of the 5-year Warranty for Non-Structural Metal Roofing System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material and Weathertightness Warranties.

##### SD-14 Samples

Accessories; FIO.

One sample of each type of flashing, trim, fascia, closure, cap and similar

items. Size shall be sufficient to show construction and configuration.

Roof Panels; FIO.

One piece of each type and finish to be used, 9 inches long, full width.

Fasteners; FIO.

Two samples of each type to be used with statement regarding intended use. If so requested, random samples of screws, bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample, approximately 1 pound, and descriptive data.

#### 1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weather tight coverings and kept dry. Material shall not be covered with plastic where such covering will allow sweating and condensation. Plastic may be used as tenting with air circulation allowed. Storage conditions shall provide good air circulation and protection from surface staining.

#### 1.7 WARRANTIES

The Non-Structural Metal Roofing System shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

##### 1.7.1 Contractor's Weathertightness Warranty

The Non-Structural Metal Roofing System shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The roofing covered under this warranty shall include the entire roofing system, including but not limited to, the roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the roof system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written

warranty shall be as outlined in attached WARRANTY FOR NON-STRUCTURAL METAL ROOF SYSTEM, and shall start upon final acceptance of the facility. It is required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the 5 year Contractor's warranty period for the entire roofing system as outlined above.

#### 1.7.2 Manufacturer's Material Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all Non-Structural Metal Roofing System components such as roof panels, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, fail structurally, or perforate under normal atmospheric conditions at the site. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing or replacing the defective coated coil material.

c. A roofing system manufacturer's 20 year system weathertightness warranty.

#### 1.8 COORDINATION MEETING

A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal roofing system contract requirements.

This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing system manufacturer, the roofing supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

### PART 2 PRODUCTS

#### 2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide nominal 16 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut. The ridge cap shall be installed as recommended by the metal roofing manufacturer. Height of corrugations, ribs, or seams, at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

##### 2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or

aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated roof panels shall be 0.024 inch thick minimum. Panels shall be within 95 percent of the nominal thickness.

## 2.2 ACCESSORIES

Accessories shall be compatible with the roofing furnished. Flashing, fascia panels, trim, metal closure strips, caps, snow guards, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.

### 2.2.1 Snow Guards

Snow guards to be a low profile, traditional style and engineered for permanent installation by means of soldering or adhesive sealant to metal roof surface. Color to match roof. Refer to plans for location.

## 2.3 FASTENERS

Fasteners for roof panels shall be zinc-coated steel, aluminum, or nylon capped steel, type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the roofing to waterproof the fastener penetration. Washer material shall be compatible with the panels; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

## 2.4 FACTORY COLOR FINISH

Panels shall have a factory applied silicone-modified polyester coating system on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 2 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 1.0 mil thickness. The exterior color finish shall meet the test requirements specified below.

### 2.4.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blistering, as determined by ASTM D 714; and a rating of 8, 1/32 inch failure at scribe, as determined by ASTM D 1654.

### 2.4.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

### 2.4.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be

considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244.

#### 2.4.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.4.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

#### 2.4.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on the steel base metal.

#### 2.4.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 30 at 60 degrees when measured in accordance with ASTM D 523.

#### 2.4.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

### 2.5 UNDERLAYMENTS

#### 2.5.1 Felt Underlayment

Felt underlayment shall be No. 30 felt in accordance with ASTM D 226, Type II.

### 2.6 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

#### 2.6.1 Rigid Board Insulation for Use Above a Roof Deck

##### 2.6.1.1 Polyisocyanurate

Polyisocyanurate insulation shall conform to ASTM C 1289, Type I, Class 2 (having a minimum recovered material content of 9 percent by weight of core

material in the polyisocyanurate portion). For impermeable faced polyisocyanurate (Ex: aluminum foil) the maximum design R-value per 1 inch of insulation used shall be 7.2.

## 2.7 INSULATION RETAINERS

Insulation retainers shall be type, size, and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

## 2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

## 2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Roof panel attachment clips shall be secured to the metal deck as a minimum, or by means recommended by the roof manufacturer. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

### 3.1.1 Roofing

Side laps shall be laid away from the prevailing winds. Side and end lap distances, joint sealing, and fastening and spacing of fasteners shall be in accordance with manufacturer's standard practice. Spacing of exposed fasteners shall present an orderly appearance. Side laps and end laps of roof panels and joints at accessories shall be sealed. Fasteners shall be driven normal to the surface. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weathertight installation. Accessories shall be fastened into substrate, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

### 3.1.2 NOT USED

### 3.1.3 Underlayment

Underlayment types shall be installed where shown on the drawings; they shall be installed directly over the substrate. If a roof panel rests directly on the underlayments, a slip sheet shall be installed as a top layer, beneath the metal roofing panels, to prevent adhesion. All underlayments shall be installed so that successive strips overlap the next

lower strip in shingle fashion. Underlayments shall be installed in accordance with the manufacturer's written instructions. The underlayments shall ensure that any water that penetrates below the metal roofing panels will drain outside of the building envelope.

### 3.2 INSULATION INSTALLATION

Insulation shall be installed as indicated and in accordance with manufacturer's instructions. Insulation shall be continuous over entire roof surface and fastened directly to the substrate with mechanical fasteners. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation and vapor retarder providing equivalent R-Value and perm rating as remaining insulation.

### 3.3 NOT USED

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION \_\_\_\_\_

BUILDING NUMBER: \_\_\_\_\_

CORPS OF ENGINEERS CONTRACT NUMBER: \_\_\_\_\_

CONTRACTOR

CONTRACTOR: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

POINT OF CONTACT: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

OWNER

OWNER: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

POINT OF CONTACT: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

CONSTRUCTION AGENT

CONSTRUCTION AGENT: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

POINT OF CONTACT: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM  
(continued)

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY \_\_\_\_\_ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON \_\_\_\_\_ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

\_\_\_\_\_  
(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOFING SYSTEM  
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOF DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

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CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM  
(continued)

\*\*REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

## SECTION 07600

## SHEET METALWORK, GENERAL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free

## INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089	(1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)
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## SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993; Errata) Architectural Sheet Metal Manual
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## 1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction.

## 1.2.1 Coordination

Cutting, fitting, drilling, and other operations in connection with sheet

metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Materials; GA.

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA-02 for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA-02. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

#### 2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

#### 2.1.2 Aluminum Extrusions

ASTM B 221, Alloy 6063, Temper T5.

#### 2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586.

#### 2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

#### 2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

#### 2.1.6 Felt

ASTM D 226, Type I.

#### 2.1.7 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 0.075 inch minimum thickness.

#### 2.1.8 Aluminum Alloy Sheet and Plate

ASTM B 209, form, alloy, and temper appropriate for use.

#### 2.1.9 Copper

ASTM B 370, Temper H 00.

#### 2.1.10 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

#### 2.1.11 Solder

ASTM B 32, 95-5 tin-antimony.

#### 2.1.12 Through-Wall Flashing

- a. Electro-sheet copper not less than 5 ounces, factory coated both sides with acid- and alkali-resistant bituminous compound not less than 6 ounces per square foot or factory covered both sides with asphalt-saturated cotton fabric, asphalt saturated glass-fiber fabric, or with 40 pound reinforced kraft paper bonded with asphalt.

#### 2.1.13 Louver Screen

Type I commercial bronze, Type II carbon steel, Type III aluminum alloy insect screening conforming to ISWA IWS 089.

### PART 3 EXECUTION

#### 3.1 GENERAL

Items such as gutters, downspouts and louvers shall be fabricated in conformance with SMACNA-02 and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

#### 3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA-02. Expansion joints in continuous sheet metal shall be provided at 40 foot intervals for copper and stainless steel and at 32 foot intervals for aluminum, except extruded aluminum fasciae which shall have expansion joints at not more than 12 foot spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

#### 3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action

by one of the following methods:

### 3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL.

### 3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

## 3.4 CONNECTIONS AND JOINTING

### 3.4.1 Soldering

Soldering shall apply to copper, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

### 3.4.2 Riveting

Joints in aluminum sheets 0.040 inch or less in thickness shall be mechanically made.

### 3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 1 inch wide. Unsoldered plain-lap seams shall lap not less than 3 inches unless otherwise specified. Flat seams shall be made in the direction of the flow.

## 3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 1/8 inch apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

## 3.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be installed as indicated. Gutters shall be supported by continuous cleats. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations.

## 3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be

covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

### 3.7.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 3 inches on centers.

### 3.7.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown in SMACNA-02. Counter flashing shall be factory formed to provide spring action against the base flashing.

### 3.7.3 NOT USED

### 3.7.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

#### 3.7.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 2 inches, or shall be applied over top of masonry and precast concrete lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

#### 3.7.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 4 inches beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill.

### 3.7.5 Valley Flashing

Valley flashing shall be installed as specified in SMACNA-02 and as indicated.

### 3.8 FASCIA

Fascia shall be fabricated and installed as indicated and in accordance with SMACNA-02.

### 3.9 INSTALLATION OF LOUVERS

Louvers shall be rigidly attached to the supporting construction. The installation shall be rain-tight. Louver screen shall be installed as indicated.

### 3.10 REGLETS

Reglets shall be a factory fabricated product of proven design, complete with fittings and special shapes as required. Open-type reglets shall be

filled with fiberboard or other suitable separator to prevent crushing of the slot during installation. Reglet plugs shall be spaced not over 12 inches on centers and reglet grooves shall be filled with sealant. Friction or slot-type reglets shall have metal flashings inserted the full depth of slot and shall be lightly punched every 12 inches to crimp the reglet and counter flashing together. Polyvinyl chloride reglets shall be sealed with the manufacturer's recommended sealant.

### 3.11 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

-- End of Section --

## SECTION 07810

## SPRAY-APPLIED FIREPROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 605	(1993; R 1996) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 759	(1992; R 1996) Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 760	(1992; R 1996) Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 761	(1992) Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 937	(1993) Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 1042	(1992) Acoustically Absorptive Materials Applied by Trowel or Spray
ASTM G 21	(1990) Determining Resistance of Synthetic Polymeric Materials to Fungi

## UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1998) Fire Resistance Directory (2 Vol.)
UL 263	(1997) Fire Tests of Building Construction and Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Fireproofing Material; GA.

Data identifying performance characteristics of fireproofing material. Data shall include recommended application requirements and indicate thickness of fireproofing that must be applied to achieve each required fire rating.

## SD-09 Reports

UL Test Assembly; GA.

Reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method.

Field Tests; FIO.

Test reports documenting results of tests on the applied material in the project. Report shall include defects identified, repair procedures, and results of the retests when required.

## SD-13 Certificates

Installer Qualifications; GA.

Manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Evidence that each fireproofing installer has had a minimum of 3 years experience in installing the specified type of fireproofing.

Surface Acceptability; FIO.

Manufacturer's certification that surfaces to be protected have been inspected and are acceptable to receive spray-applied fireproofing. The statement shall list the structural members and the areas that have been inspected and certified.

Manufacturer's Inspection; GA.

Manufacturer's certification that the spray-applied fireproofing in the entire project complies with the manufacturer's criteria and recommendations.

## SD-14 Samples

Spray-Applied Fireproofing; FIO.

One sample panel, 18 inches square, for each specified type of fireproofing. Also, a designated sample area of not less than 100 square feet shall be prepared. Sample area shall be representative of typical installation of fireproofing including metal decks, beams, columns and attachments. Equipment, materials and procedures used in the sample area shall be the same as, or representative of, that to be used in the work. The sample area shall be approved prior to proceeding with fireproofing work in any other area. The approved sample area shall be used as a reference standard for applied fireproofing material. Sample area shall remain in place and open to observation until all spray-applied fireproofing is completed and accepted, at which time it may become part of the work.

## 1.3 DELIVERY AND STORAGE

Packaged material shall be delivered in the original unopened containers, marked to show the names of the brand and the manufacturer. Fireproofing material shall be kept dry until ready to be used, and shall be stored off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Material with shelf-life shall be applied prior to expiration of the shelf-life.

#### 1.4 ENVIRONMENTAL CONDITIONS

##### 1.4.1 Temperature

Substrate and ambient air temperatures shall be maintained above 40 degrees F during application and for 24 hours before and after application. Relative humidity shall be maintained within the limits recommended by the fireproofing manufacturer.

##### 1.4.2 Ventilation

Adequate ventilation shall be provided to properly dry the fireproofing after application. In enclosed areas, a minimum of 4 air exchanges per hour shall be provided by forced air circulation.

#### 1.5 INSTALLER QUALIFICATIONS

Each installer of fireproofing material shall be trained and have a minimum of 3 years experience in the installation of fireproofing of the type specified.

#### 1.6 NOT USED

#### 1.7 FIRE RESISTANCE RATING

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resist Dir. Proposed materials not listed in UL Fire Resist Dir shall have fire resistance ratings at least equal to the UL Fire Resist Dir ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E 119.

#### 1.8 EXTENT OF FIREPROOFING

Structural steel, roof purlins, wall girts, and the underside of steel floor and steel roof decks shall be protected with spray-applied fireproofing to a fire resistance hour-rating of 1 hour unless otherwise indicated.

### PART 2 PRODUCTS

#### 2.1 SPRAY-APPLIED FIREPROOFING

Spray-applied fireproofing material, including sealer, shall conform to ASTM E 1042, Class (a), Category A, either Type I or Type II, except that the dust removed shall not exceed 0.0025 gram per square foot of fireproofing material applied as specified in the project. Material shall be asbestos free, and shall resist fungus for a period of 28 days when tested in accordance with ASTM G 21.

##### 2.1.1 Dry Density and Cohesion/Adhesion

Fireproofing shall have a minimum ASTM E 605 dry density and ASTM E 736 cohesion/adhesion properties as follows:

##### 2.1.1.1 Concealed Structural Components

Fireproofing for structural components concealed above the ceiling, or within a wall, chase, or furred space, shall have a minimum average applied

dry density of 15 pounds per cubic foot and a cohesion/adhesion strength of 200 pounds per square foot.

#### 2.1.1.2 Exposed Structural Components

Fireproofing for exposed structural components, except where otherwise specified or indicated, shall have a minimum applied dry density of 22 pounds per cubic foot and a cohesion/adhesion strength of 300 pounds per square foot.

#### 2.1.1.3 Mechanical Rooms and Storage Areas

Fireproofing for structural components located in mechanical rooms and storage areas shall have a minimum applied dry density of 40 pounds per cubic foot and a cohesion/adhesion strength of 400 pounds per square foot.

#### 2.1.2 Deflection

Spray-applied fireproofing shall not crack, spall, or delaminate when tested in accordance with ASTM E 759.

#### 2.1.3 Bond-Impact

Spray-applied fireproofing material shall not crack, spall or delaminate when tested in accordance with ASTM E 760.

#### 2.1.4 Compressive Strength

The minimum compressive strength shall be 1000 psf when tested in accordance with ASTM E 761.

#### 2.1.5 Corrosion

Spray-applied fireproofing material shall not contribute to corrosion of test panels when tested as specified in ASTM E 937.

#### 2.2 SEALER

Sealer shall be the type approved by the manufacturer of the fireproofing material and shall be white color.

#### 2.3 WATER

Water used for material mixing and surface preparation shall be potable.

### PART 3 EXECUTION

#### 3.1 SURFACE PREPARATION

Surfaces to be fireproofed shall be thoroughly cleaned of dirt, grease, oil, paint, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be coordinated with the manufacturer and detailed in submittal item SD-01 Data.

#### 3.2 PROTECTION

Surfaces not to receive spray-applied fireproofing shall be covered to prevent contamination by splatter, rebound and overspray. Exterior

openings in areas to receive spray-applied fireproofing shall be covered prior to and during application of fireproofing with tarpaulins or other approved material. Surfaces not to receive fireproofing shall be cleaned of fireproofing and sealer.

### 3.3 MIXING

Fireproofing material shall be mixed in accordance with the manufacturer's recommendations.

### 3.4 APPLICATION

#### 3.4.1 Sequence

Prior to application of fireproofing on each floor, the manufacturer shall inspect and approve application equipment, water supply and pressure, and the application procedures. Fireproofing shall be applied to underside of steel roof deck or steel floor assemblies only after respective roof or floor construction is complete. Fireproofing material shall be applied prior to the installation of ductwork, piping and conduits which would interfere with uniform application of the fireproofing. The Contractor shall not allow roof traffic during application and curing period.

#### 3.4.2 Application Technique

Water pressure and volume shall be maintained to manufacturer's recommendations throughout the fireproofing application. Fireproofing material shall be applied to the thickness established for the specified fire resistance rating, in accordance with the procedure recommended by the manufacturer, and to a uniform density and texture. Fireproofing material shall not be tamped to achieve the desired density. Sealer shall be applied to all fireproofing.

### 3.5 FIELD TESTS

The applied fireproofing shall be tested by an approved independent testing laboratory, in approved locations, for density, cohesion/adhesion force as specified, and for thickness in accordance with ASTM E 605. Two sets of tests shall be conducted on each floor or 10,000-square-foot area, whichever is less, at the approved locations. Any area showing less than minimum requirements shall be corrected. Proposed corrective measures, in writing, shall be approved before starting the corrective action. Corrected work shall be retested.

#### 3.5.1 Thickness, Density, Cohesion/Adhesion

Each structural component type shall be tested at floor and roof decks, beams, columns, joists, and trusses. Minimum average thickness shall be as indicated. Density and cohesion/adhesion shall be as specified.

#### 3.5.2 Repair

Additional fireproofing material may be added to provide proper thickness. Rejected areas of fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied. Repaired areas shall be retested and reinspected. Fireproofing material shall be applied to voids or damaged areas by hand-trowel, or by respraying.

-- End of Section --

## SECTION 07900

## JOINT SEALING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1981; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Backing; GA. Bond-Breaker; GA.

Sealant; GA.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

## SD-13 Certificates

Sealant; GA.

Certificates of compliance stating that the materials conform to the specified requirements.

## 1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

## 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

## PART 2 PRODUCTS

### 2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

#### 2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 1, open cell, or Type 2, closed cell, Class A, round cross section.

#### 2.1.2 PVC

Polyvinyl chloride (PVC) backing shall be ASTM D 1565, Grade VO 12, open-cell foam, round cross section.

#### 2.1.3 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods or tubes.

#### 2.1.4 Neoprene

Neoprene backing shall be ASTM D 1056, open cell neoprene sponge Type 1, Class C, Grade 1C3.

### 2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

### 2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

### 2.4 NOT USED

### 2.5 SEALANT

#### 2.5.1 LATEX

Latex Sealant shall be ASTM C 834.

#### 2.5.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. Polysulfide Sealant: Type S, Grade NS, Class 25, Use NT, M, G, A, O.
- b. Polyurethane sealant: Grade NS, Class 25, Use T, NT, M, G, A, O.

c. Silicone sealant: Type S, Grade NS, Class 25, Use NT, M, G, A, O.

2.5.3 NOT USED

2.5.4 BUTYL

Butyl sealant shall be ASTM C 1085.

2.5.5 NOT USED

2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has

been filled and tooled.

### 3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

### 3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

### 3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

### 3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

## 3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

-- End of Section --

## SECTION 08110

## STEEL DOORS AND FRAMES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 976	(1990) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box
ASTM D 2863	(1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

## DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115.1G	(1994) Installation Guide for Doors and Hardware
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## STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames
SDOI SDI-106	(1996) Standard Door Type Nomenclature
SDOI SDI-107	(1984) Hardware on Steel Doors (Reinforcement - Application)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Steel Doors and Frames; GA.

Drawings using standard door type nomenclature in accordance with SDOI SDI-106 indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of

metal. Drawings shall include catalog cuts or descriptive data for the doors, frames, and weatherstripping including air infiltration data and manufacturers printed instructions.

#### SD-13 Certificates

Thermal Insulated Doors; GA.

- a. Certification of Thermal Insulating Rating: Certification or test report for thermal insulated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

### 1.3 DELIVERY AND STORAGE

During shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or shall be provided with temporary steel spreaders at the bottom of each frame; and knockdown type frames shall be securely strapped in bundles. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting air circulation. Doors and assembled frames shall be stored in an upright position in accordance with DHI A115.1G.

Abraded, scarred, or rusty areas shall be cleaned and touched up with matching finishes.

### 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with SDOI SDI-100 and the additional requirements specified herein. Door grade shall be extra heavy duty (Grade III) unless otherwise indicated on the door and door frame schedules. Exterior doors and frames shall be designation G60 galvanized. Indicated interior doors and frames shall be designation A40 galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section 08700 BUILDERS' HARDWARE. Doors and frames shall be reinforced, drilled, and tapped to receive mortised hinges, locks, latches, and flush bolts as required. Doors and frames shall be reinforced for surface applied hardware. Frames shall be welded type located as shown. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 18 gauge steel or 7 gauge diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall be furnished for installation into factory predrilled holes in door frames; adhesively applied silencers are not acceptable. Where frames are installed in plaster or masonry walls, plaster guards shall be provided on door frames at hinges and strikes. Full glass doors shall conform to SDOI SDI-100, Model 3, and shall include provisions for glazing. Reinforcing of door assemblies for closers and other required hardware shall be in accordance with SDOI SDI-100 and the conditions of the fire door assembly listing when applicable. Exterior doors shall have top edges closed flush and sealed against water penetration.

### 2.2 NOT USED

### 2.3 THERMAL INSULATED DOORS

The interior of thermal insulated doors shall be completely filled with

rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 0.41 btu/hr times sq f times f when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

2.4 NOT USED

2.5 NOT USED

2.6 WEATHERSTRIPPING

Unless otherwise specified in Section 08700 BUILDERS' HARDWARE, weatherstripping shall be as follows: Weatherstripping for head and jamb shall be manufacturer's standard elastomeric type of synthetic rubber, vinyl, or neoprene and shall be installed at the factory or on the jobsite in accordance with the door frame manufacturer's recommendations. Weatherstripping for bottom of doors shall be as shown. Air leakage rate of weatherstripping shall not exceed 0.20 cfm per linear foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 FACTORY FINISH

Doors and frames shall be phosphatized and primed with standard factory primer system.

### PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with DHI A115.1G. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Weatherstripping shall be installed at exterior door openings to provide a weathertight installation. Hollow metal door frames shall be solid grouted in masonry walls as shown.

3.1.1 Thermal Insulated Doors

Hardware and perimeter seals shall be adjusted for proper operation. Doors shall be sealed weathertight after installation of hardware and shall be in accordance with Section 07900 JOINT SEALING.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be as indicated in the Exterior Finish Key.

-- End of Section --

## SECTION 08120

## ALUMINUM DOORS AND FRAMES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## 1.2 SYSTEM DESCRIPTION

Frames and swing-type aluminum doors, of size and design shown on the drawings, shall be provided at the locations indicated. Frames shall be furnished complete with doors, subframes, trim, and other accessories indicated and specified.

## 1.3 PERFORMANCE REQUIREMENTS

## 1.3.1 Wind Load Performance

Doors and frames shall be of sufficient strength to withstand a design wind load of 30 pounds per square foot of supported area with a deflection of not more than 1/175 times the length of the member. Doors shall be tested in accordance with ASTM E 330 at a pressure not less than 1.5 times the design load.

## 1.3.2 Water Penetration Performance

Frames and fixed areas, and non-handicap complying doors shall have no water penetration when tested in accordance with ASTM E 331 at a pressure of 8 psf.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTALS

## PROCEDURES:

## SD-01 Data

Aluminum Doors and Frames; GA.

Manufacturer's descriptive data and catalog cuts including air-infiltration data.

## SD-04 Drawings

Aluminum Doors and Frames; GA.

A schedule showing the location of each door shall be included with the drawings. Drawings showing elevations of each door and frame type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, and details of joints and connections.

## SD-06 Instructions

Installation; FIO. Cleaning; FIO.

Manufacturer's installation instructions and cleaning instructions.

## SD-09 Reports

Aluminum Doors; GA.

For full-glazed doors, certified test reports from an independent testing laboratory, stating that doors are identical in design, materials, and construction to a door that has been tested and meets all test and specified requirements.

## SD-14 Samples

Finishes; GA.

Samples of the color anodized coating, showing the extreme color range.

## 1.5 DELIVERY AND STORAGE

Materials delivered to the jobsite shall be inspected for damage, and shall be unloaded with a minimum of handling. Storage shall be in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy access for inspecting and handling. Materials shall be neatly stored on the floor, properly stacked on nonabsorptive strips or wood platforms. Doors and frames shall not be covered with tarps, polyethylene film, or similar coverings.

## 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

## PART 2 PRODUCTS

## 2.1 ALUMINUM DOORS AND FRAMES

Extrusions shall comply with ASTM B 221, Alloy 6063-T5 or -T6, except alloy used for anodized color coatings shall be required to produce the specified color. Aluminum sheets and strips shall comply with ASTM B 209, alloy and temper best suited for the purpose. Fasteners shall be hard aluminum or stainless steel.

### 2.1.1 Finishes

Finish shall be clear anodized. Clear anodized finish shall be AA-M10C22A41.

### 2.1.2 Welding and Fastening

Where possible, welds shall be located on unexposed surfaces. Welds required on exposed surfaces shall be smoothly dressed. Welding shall produce a uniform texture and color in the finished work, free of flux and spatter. Exposed screws or bolts will be permitted only at inconspicuous locations and shall have heads countersunk.

### 2.1.3 Anchors

Anchors shall be stainless steel or steel with a hot-dipped galvanized finish. Anchors of the sizes and shapes required shall be provided for securing aluminum frames to adjacent construction. Anchors shall be placed near top and bottom of each jamb and at intermediate points not more than 25 inches apart. Door frames free of window wall system shall be reinforced and securely anchored to floor construction.

### 2.1.4 Hardware

Hardware for aluminum doors is specified in Section 08700 BUILDERS' HARDWARE. Doors and frames shall be cut, reinforced, drilled, and tapped at the factory to receive template hardware. Reinforcement shall be provided in the core of doors as required to receive locks, door closers, and other hardware. Doors to receive surface applied hardware shall be reinforced as required.

### 2.1.5 Glazing

Glazing shall be as specified in Section 08840 PLASTIC GLAZING. Metal glazing beads, vinyl inserts, and glazing gaskets shall be provided for securing glazing. Glazing stops shall be tamperproof on exterior side.

### 2.1.6 Weatherstripping

Weatherstripping shall be continuous silicone-treated wool pile type, or a type recommended by the door manufacturer and shall be provided on head and jamb of exterior door frames. Weatherstripping for bottom of doors shall be as shown. Weatherstripping shall be easily replaced without special tools, and shall be adjustable at meeting stiles of pairs of doors. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

## 2.2 ALUMINUM FRAMES

Frames shall be non-glazed for doors only. Frames shall be fabricated of extruded aluminum shapes to contours as shown on the drawings. Shapes shown are representations of design, function, and required profile. Dimensions shown are minimum. Shapes of equivalent design may be submitted, subject to approval of samples. Minimum metal wall thickness shall be 0.090 inch, except glazing beads, moldings, and trim shall be not less than 0.050 inch. Joints in frame members shall be milled to a hairline tight fit so that raw edges of the assembly are not visible, sealed internally to prevent water infiltration, reinforced, and secured mechanically by appropriate screws or by screw spline attachment.

## 2.3 ALUMINUM DOORS

Doors shall be not less than 1-3/4 inches thick. Clearances at hinge stiles, lock stiles and top rails, floors and thresholds, shall comply with

manufacturer's standard. Single-acting doors shall be beveled 1/8 inch at lock and meeting stile edges.

#### 2.3.1 Full-Glazed Stile and Rail Doors

Doors shall have medium stiles and rails as shown, and shall be fabricated from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Top and bottom rail shall be fastened together by means of welding or by 3/8 inch diameter plated tensioned steel tie rods. An adjustable mechanism shall be provided in the top rail of narrow stile doors to allow for minor clearance adjustments after installation. Extruded aluminum snap-in glazing beads shall be provided on interior side of doors. Extruded aluminum theft-proof snap-in glazing beads or fixed glazing beads shall be provided on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets, designed to receive glazing of thickness required. Glazing is specified in Section 08840 PLASTIC GLAZING.

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF DOORS, FRAMES, AND ACCESSORIES

##### 2.4 Protection of Aluminum

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods.

##### 2.4.1 Paint

Aluminum surfaces to be protected shall be solvent cleaned and given a coat of zinc-molybdate primer and one coat of aluminum paint.

##### 2.4.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and shall be cemented to the aluminum surface using a cement compatible with aluminum.

##### 2.5 Installation

Frames and framing members shall be accurately set in position to receive adjoining components. Frames shall be plumb, square, level, and in alignment, and securely anchored to adjacent construction. Metal-to-metal joints between framing members and joints between framing members and building surfaces shall be sealed as specified in Section 07900 JOINT SEALING. Doors shall be accurately hung with proper clearances, and adjusted to operate properly.

## SECTION 08210

## WOOD DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI-02 (1994) Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program

## NATIONAL WOOD WINDOW &amp; DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1-A (1993) Architectural Wood Flush Doors

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Products

Doors shall be of the type, size, and design indicated on the drawings, and shall be the standard products of manufacturers regularly engaged in the manufacture of wood doors.

## 1.2.2 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door. The identifying mark or a separate certification shall include identification of the standard on which construction of the door is based, identity of the manufacturing plant, identification of the standard under which preservative treatment, if used, was made, and identification of the doors having a Type I glue bond.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Wood Doors and Frames; GA.

Drawings indicating the location of each door, elevation of each type of door, details of construction, marks to be used to identify the doors, and location and extent of hardware blocking. Drawings shall include catalog cuts or descriptive data for doors, weatherstripping, flashing, and thresholds to be used.

## SD-06 Instructions

Wood Doors; FIO.

Manufacturers preprinted installation and touch-up instructions.

## SD-13 Certificates

Adhesives; FIO.

Certificate stating that adhesives used for proposed doors do not contain any formaldehyde.

## SD-14 Samples

Factory Coated Natural Finish; FIO.

Samples of factory applied natural finish.

## 1.4 STORAGE

Doors shall be stored in fully covered areas and protected from damage and from extremes in temperature and humidity. Doors shall be stored on supports to prevent warping or twisting, and to provide ventilation. Factory cartons or wrappers shall be kept intact until installation.

## 1.5 HARDWARE

Hardware, including weatherstripping and thresholds, is specified in Section 08700 BUILDERS' HARDWARE.

## 1.6 NOT USED

## 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

## 2.1 GENERAL FABRICATION REQUIREMENTS

## 2.1.1 Edge Sealing

Wood end-grain exposed at edges of doors shall be sealed prior to shipment.

## 2.1.2 NOT USED

## 2.1.3 Adhesives

Adhesives shall be in accordance with NWWDA I.S. 1-A, requirements for Type II Bond Doors (water-repellent) for interior doors. Adhesive for doors to receive a transparent finish shall be nonstaining. Adhesives shall contain no formaldehydes.

## 2.1.4 Prefitting

Doors shall be furnished prefitted or unfitted at the option of the Contractor.

## 2.2 FLUSH DOORS

Flush doors shall be solid core as shown and shall conform to NWWDA I.S. 1-A, except for the one year acclimatization requirement in paragraph T-2, which shall not apply. Wood doors shall be 5-ply or 7-ply construction with faces, stiles, and rails bonded to the cores.

## 2.2.1 Core Construction

## 2.2.1.1 Solid Cores

Door construction shall be glued wood block core with vertical and horizontal edges bonded to the core.

## 2.2.2 Face Panels

### 2.2.2.1 Natural Finished Wood Veneer Doors

Veneer doors to receive natural finish shall be Premium Grade, book matched red oak veneer in accordance with NWWDA I.S. 1-A. Vertical stile strips shall be selected to provide edges of the same species and/or color as the face veneer. Door finish shall be in accordance with paragraph FIELD FINISHING.

## 2.3 NOT USED

## 2.4 NOT USED

## 2.5 MOULDING AND EDGING

Moulding and edging shall be as shown. Wood species for transparent finished doors shall be compatible with veneer.

## 2.6 NOT USED

## 2.7 NOT USED

## 2.8 FINISHING

### 2.8.1 Factory Coated Natural Finish

Doors indicated to receive factory coated natural finish shall be given a transparent finish conforming to AWI-02, Section 1500, Premium Grade, medium stain, full gloss sheen, open grain effect. Finish shall be AWI factory finish system Number TR3 or TR4. Color of the natural finish shall be in accordance with Interior Finish Key STN-1. Edges of unfitted doors shall be field finished after fitting to the frames.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF DOORS

#### 3.1.1 General Use Doors

Doors shall be fit, hung, and trimmed as required. Door shall have a clearance of 1/8 inch at the sides and top and shall have a bottom clearance of 1/4 inch over thresholds and 1/2 inch at other locations unless otherwise shown. The lock edge or both edges of doors shall be beveled at the rate of 1/8 inch in 2 inches. Cuts made on the job shall be sealed immediately after cutting, using a clear varnish or sealer. Bottom of doors shall be undercut to allow clear door swing over carpeted areas. Vertical edges of doors which have not been rounded or beveled at the factory shall be eased when the doors are installed.

-- End of Section --

## SECTION 08315

## BLAST RESISTANT DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S302	(1986) Code of Standard Practice for Steel Buildings and Bridges
AISC S335	(1989) Structural Steel Buildings - Allowable Stress Design, Plastic Design
AISC S328L	(1986) Load and Resistance Factor Design Specifications for Structural Steel Buildings

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1989) Structural Steel
ASTM A 123	(1989) (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982) (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1990) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	(1990) High-Strength Bolts for Structural Steel Joints
ASTM A 563	(1990) Carbon and Alloy Steel Nuts
ASTM A 780	(1980) (R 1987) Repair of Damaged Hot-Dip Galvanized Coatings
ASTM F 436	(1990) Hardened Steel Washers
ASTM F 844	(1990) Washers, Steel, Plain (Flat) Unhardened for General Use
ASTM E 165	(1980) Practice for Liquid Penetrant Inspection Method
ASTM E 709	(1980) (R 1985) Practice for Magnetic Particle Examination

## AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1990) Structural Welding Code Steel, Twelfth Edition
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## FEDERAL SPECIFICATIONS (FS)

FS TT-P-645 (Rev. B) Primer, Paint, Zinc-Molybdate Alkyd Type

FS TT-P-664 (Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC Compliant

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-SP 6 1989 Commercial Blast Cleaning

1.2 SUBMITTALS

Submit the following shall be submitted in accordance with Section 01300 SUBMITTALS:

1.2.1 SD-04, Drawings

- a. Blast Resistant Doors Including Framing and Supports

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.2.2 SD-13 Certificates

- a. Structural Steel
- b. High Strength Bolts
- c. Welding Electrodes and Rods
- d. Track
- e. Shop Primer

1.3 QUALIFICATIONS

1.3.1 Qualification of Welders

Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.3.2 Qualification of Manufacturer and Installer

- a. Manufacturer and installation of blast resistant doors, frames and door stops shall be performed by the blast door manufacturer who shall be fully responsible for the door fabrication, erection, operating mechanisms, and performance. The manufacturer shall have at least two years of proven successful experience in the design, fabrication and installation of similar blast resistant doors. The manufacturer shall be regularly engaged in this type of work and shall have complete facilities, equipment, and technical personnel for the design, fabrication, installation and testing of complete door systems.
- b. The Contractor shall submit for approved, information to confirm that the manufacturer's qualifications are in conformance with this specification. A list of previously successfully completed installations of a similar nature indicating the name and address of the owner and dates of installation shall be included with this information.

- c. The manufacturer shall be fully responsible for furnishing and installing blast doors complete with all equipment and materials required to provide a complete installation ready to operate.

#### 1.4 DELIVERY, STORAGE, AND PROTECTION

Protection from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Structural

ASTM A 36/A 36M.

##### 2.1.1 Bolts, Nuts, and Washers

###### 2.1.1.1 Bolts

The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

- a. Anchor Bolts: ASTM A 307, Grade A.
- b. High Strength Bolts: ASTM A 325, Type 1 or 2.

###### 2.1.1.2 Nuts

ASTM A 563, Grade A, heavy hex style, except nuts under 1.5 inches may be provided in hex style.

###### 2.1.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 bolts.

##### 2.1.2 Welding Electrodes and Rods

AWS D1.1.

##### 2.1.3 Shop Primer

FS TT-P-664 or FS TT-P-645 conforming to Federal, State, and local VOC regulations. If flash rusting occurs, reclean the surface prior to application of primer.

#### 2.2 FABRICATION

##### 2.2.1 Blast Resistant Doors

Fabricate doors in accordance with the applicable provisions of AISC S335 or AISC S328L. Workmanship shall be equal to standard commercial practice in modern metal shops. Fabricate and assemble in the shop to the greatest extent possible.

###### 2.2.1.1 Welding of Steelwork

In accordance with AWS D1.1. For the doors, welding might cause serious residual stresses, therefore, Contractor shall submit for approval by the Contracting Officer a detailed sequence of the welding, amplifying the requirements given by the AWS specifications.

### 2.2.1.2 Stud Welding

In accordance with AWS D1.1. Stud manufacturer's representative shall be in attendance for welding of the studs.

### 2.2.2 Miscellaneous Accessories

#### 2.2.2.1 Weatherstripping

Weatherstripping seals shall be flap-type, two-ply, cloth-inserted neoprene or extruded, double flap, single or dual opposed solid neoprene material on vertical edges and sills. The two-ply material shall have a minimum thickness of 1/8 inch and shall be retained continuously for its full length and secured with stainless steel fasteners inches o.c. Extruded weatherstripping with heavy center section shall be attached at 6 inches o.c., but continuous bar may be omitted. Clearance between metal parts on vertical edges of leaves and between leaves and jambs which are to be weatherstripped shall be as indicated.

### 2.3 FABRICATION FINISHES

#### 2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123 or ASTM A 153.

#### 2.3.2 Galvanize

Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces in which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

#### 2.3.4 Shop Cleaning and Painting

##### 2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC-SP 6. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.

##### 2.3.4.2 Pretreatment, Priming and Painting

Apply pretreatment and primer in accordance with manufacturer's printed instructions. Painting to be in accordance with Section 09900.

### PART 3 EXECUTION

#### 3.1 ERECTION

##### 3.1.1 Procedure

Erect in accordance with the AISC S335 or AISC S328L. Use erecting equipment suitable for the work and in first class condition. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Contracting Officer and obtain approval of the method of correction; make the correction in his presence. The straightening of plates and angles or other shapes shall be done by the methods approved by the Contracting Officer. If heating of metal is approved for straightening, it shall not be to a higher temperature than that producing a dark "cherry red" color. After heating, the metal shall be cooled as slowly as possible. There shall be no evidence of fracture on the surface of the metal after straightening. Drain steelwork properly; fill pockets exposed to the weather with an approved waterproof material.

### 3.1.2 Connections

Provide anchor bolts and other connections between the steel and concrete and properly locate and build into connecting work. Design connections for which details are not indicated in accordance with AISC S335 or AISC S328L.

### 3.1.3 High-Strength Bolting

Specification for structural joints using ASTM A 325 bolts, approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation shall govern the furnishing and installation of high-strength bolting, with the following modifications. Alternate fasteners, specified in paragraph 2(d) will not be permitted.

### 3.1.4 Erection Tolerances

In accordance with the AISC S302.

### 3.1.5 Temporary Welds and Backing Strips

Temporary Welds and Backing Strips shall be removed.

### 3.1.6 Field Painting

All exposed surfaces of the steelwork including the blast-resistant doors shall be field painted as specified in Section 09900, "Painting."

## 3.2 FIELD INSPECTION AND TESTS

### 3.2.1 Inspection

The manufacturer of the doors shall provide a field inspection engineer to perform the following:

- a. Check installation of embedded items before pouring of concrete (after forms or shoring are in place) to insure that the dimensional tolerances recommended by door manufacturer have been complied with.
- b. Re-check embedded items to verify the accuracy of dimensions after shoring and forms are removed from concrete.
- c. Supervise any necessary corrective action.
- d. Supervise the job site assembly and installation of the doors and operators.
- e. Inspect final assembly of doors and operators after corrections and adjustments have been made to doors, seals, and when doors are ready to be operated.

### 3.2.2 Visual Inspection of Welding

Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and thoroughly clean them before the inspector makes the check inspection. Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slab inclusions; excessive roughness, unfilled craters, gas pockets, undercuts, overlaps, size and insufficient throat and concavity. Inspect the preparation of groove welds for adequate throat opening and for snug position of back-up-bars.

### 3.2.3 Nondestructive Testing of Fillet Welds

Welds connecting structural steel members shall be inspected and tested over their entire length in accordance with the weld quality and standards of acceptance of AWS D1.1. Fillet welds shall be inspected by one of the following:

#### 3.2.3.1 Magnetic Particle Inspection

Methods shall be in accordance with ASTM E 709.

#### 3.2.3.2 Liquid Penetrant Inspection

Methods shall be in accordance with ASTM E 165.

### 3.2.4 Penetrant Welds

All full or partial penetration welds, shall be subjected to 100 percent ultrasonic examination. All penetrant joints shall be considered to be tension joints. All testing shall be performed by a testing laboratory approved by the Government. The testing laboratory shall be responsible for interpretation of the testing, which shall be certified and submitted in a written report for each test. In addition to the weld examination performed by the Contractor, the Contracting Officer reserved the right to perform independent examination of any welds at any time. Except for material handling assistance, the cost of all Government examination will be borne by the Government.

#### 3.2.4.1 Ultrasonic Inspection of Penetrant Welds

Technique and standards of acceptance shall be in accordance with AWS D1.1.

## 3.3 STEEL DOORS

### 3.3.1 Operation

Doors shall be manually operated by a spur gear hand chain operator. Operation shall be by pulling on an endless chain through a stationary gearbox with maximum 18-pound pull to move the door. Gear reduction ratio shall be 4.4 to 1 or less. The door operator shall not include a clutch. The hand chain wheel shall be equipped with a chain guide that will permit operation of the hand chain at an angle 10 degrees out from either side of the chain wheel without stripping or jumping the wheel rim. All load carrying parts of the operator shall resist, without damage or permanent deformation, a load of 400 pounds applied vertically to either side of the hand chain while the door is restrained from moving. The door operator shall be equipped with a manual emergency chain release which will release the door from the drive chain. The drive chain will remain intact with the emergency chain release engaged or disengaged. The emergency chain release shall be located as indicated on the drawing. The door shall be provided with a latching mechanism to secure the release both in the engaged and in the disengaged positions. A bolt and nut type locking mechanism will not be acceptable.

### 3.3.2 Door Trolleys

Trolleys shall have sealed ball bearings and shall be designed to ensure ease of operation and uniform loading of wheels. Side plates shall be of malleable iron and shall be connected to each other with at least two through-bolts in addition to the yoke connection.

-- End of Section --

## SECTION 08330

## OVERHEAD ROLLING DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 330	(1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Fundament HDBK-IP	(1997) Handbook, Fundamentals I-P Edition
ASHRAE Fundament HDBK-SI	(1997) Handbook, Fundamentals SI Edition

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993; Rev 1, Rev 2, Rev 3) Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata 96-4) National Electrical Code
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## 1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing

company certifying that the door and operator have been designed to meet the specified requirements.

#### 1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 30 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load.

The door shall support the superimposed loads for a minimum period of 10 seconds without evidence of serious damage and shall be operable after conclusion of the tests. Test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. The uniform static load test specimen shall be supported using guides, endlocks, and windlocks as required for project installation.

Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed.

#### 1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per hour. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Overhead Rolling Door Unit; GA.

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

#### SD-04 Drawings

Overhead Rolling Door Unit; GA.

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

#### SD-06 Instructions

Overhead Rolling Door Unit; FIO.

Manufacturer's preprinted installation instructions.

#### SD-09 Reports

Tests; FIO.

Windload test data.

#### SD-14 Samples

Overhead Rolling Door Unit; GA.

Manufacturer's standard color samples of factory applied finishes.

#### SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Maintenance and Repair Manual ; FIO.

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

### 1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

### 1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

## PART 2 PRODUCTS

### 2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls as indicated.

#### 2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0269 inches. Steel slats for doors from 15 feet wide to 21 feet wide shall be minimum bare metal thickness of 0.0329 inches. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

##### 2.1.1.1 NOT USED

##### 2.1.1.2 Insulated Curtains

The slat system shall supply a minimum R-value of 4 when calculated in accordance with ASHRAE Fundament HDBK-IP ASHRAE Fundament HDBK-SI. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a urethane core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as

specified for curtains. Interior face shall be not lighter than 0.0209 inches. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

#### 2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have steel endlocks of manufacturer's stock design. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.]

#### 2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors. A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

#### 2.1.4 Guides

Guides shall be steel structural shapes of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

#### 2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe.

#### 2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

#### 2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

#### 2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.0209 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

#### 2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

## 2.1.10 NOT USED

## 2.1.11 Operation

Doors shall be operated by means of electric power with auxiliary chain hoist. Equipment shall be designed and manufactured for usage in hazardous Class II, Division 1 Areas.

## 2.1.11.1 NOT USED

## 2.1.11.2 NOT USED

## 2.1.11.3 NOT USED

## 2.1.11.4 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, necessary means of reduction for medium-duty doors, self-locking worm gear in oil bath for heavy-duty doors, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate emergency manual operation of the door in case of electrical failure. Auxiliary operation shall be by means of bronze (in hazardous areas) endless chain extending to within 3 feet of the floor. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient horsepower and torque output to move the door in either direction from any position at a speed range of 6 to 8 inches per second without exceeding the rated capacity. Motors shall be suitable for operation on 208 volts, 60 hertz, 3-phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, in accordance with NFPA 70. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. Each control station shall be of the three position button type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the constant pressure type. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have an electric sensing edge for hazardous areas that will reverse the door movement upon contact with an obstruction and cause the

door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

#### 2.1.12 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.

#### 2.1.13 Locking

Locking for motor operated doors shall consist of self-locking gearing with chain lock for emergency hand chain.

#### 2.1.14 Finish

Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on finish coat. The paint system shall withstand a minimum of 1500 hours without blistering, bubbling, or rust. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be sandstone.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

-- End of Section --

SECTION 08520  
ALUMINUM WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980; R 1993) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA AAMA/NWWDA 101 I.S.2 (1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

ASTM E 547 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1997; Errata 97-1) Life Safety Code

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA ANSI/SMA 1004 (1987) Aluminum Tubular Frame Screens for Windows

1.2 WINDOW PERFORMANCE

Aluminum windows shall be designed to meet the following performance

requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

#### 1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA AAMA/NWWDA 101 I.S.2 for the window types and classification specified in this section.

#### 1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA AAMA/NWWDA 101 I.S.2 for each window type when tested in accordance with ASTM E 283.

#### 1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA AAMA/NWWDA 101 I.S.2 for each window type when tested in accordance with ASTM E 547.

#### 1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows shall not exceed R-Value Class R3.33.

#### 1.2.5 Life Safety Criteria

Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Aluminum Windows; GA.

Manufacturer's descriptive data and catalog cut sheets.

#### SD-04 Drawings

Aluminum Windows; GA. Insect Screens; GA.

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, and window schedules showing locations of each window type.

#### SD-06 Instructions

Aluminum Windows; FIO.

Manufacturer's preprinted installation instructions and cleaning

instructions.

#### SD-09 Reports

Aluminum Windows; GA.

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

#### SD-13 Certificates

Aluminum Windows; GA.

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates.

#### SD-14 Samples

Aluminum Windows; GA.

Manufacturer's standard color samples of the specified finishes.

### 1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

### 1.5 NOT USED

### 1.6 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glazing, frame, weatherstripping, screens, and hardware. Windows shall conform to AAMA AAMA/NWWDA 101 I.S.2. Windows shall be pre-glazed with 1" heavy-duty insulated triple wall extruded polycarbonate structural sheet..

#### 2.1.1 NOT USED

#### 2.1.2 Casement Windows

Aluminum casement (C) windows shall conform to AAMA AAMA/NWWDA 101 I.S.2 Designation C-HC40 type with ventilators which swing on side jamb. Hinges shall be butt (close-up) type. Operators shall be roto-type. Locking devices shall be provided to secure ventilators tightly in the frame in the closed position.

### 2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA AAMA/NWWDA 101 I.S.2, and shall be manufactured of material compatible with aluminum and resistant to weather.

Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

### 2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design. Insect screens shall be fabricated of roll-formed tubular-shaped aluminum frames conforming to SMA ANSI/SMA 1004 and (18 x 16) aluminum mesh screening conforming with ISWA IWS 089, Type III.

### 2.4 ACCESSORIES

#### 2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, stainless steel, cadmium-plated steel, nickel/chrome-plated steel in compliance with AAMA AAMA/NWWDA 101 I.S.2. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

#### 2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel in accordance with requirements established by AAMA AAMA/NWWDA 101 I.S.2.

#### 2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA AAMA/NWWDA 101 I.S.2.

### 2.5 GLAZING

Units shall be complete with glazing to meet AAMA AAMA/NWWDA 101 I.S.2. Glazing material shall be compatible with aluminum, and shall not require painting.

### 2.6 FINISH

#### 2.6.1 Anodized Aluminum Finish

Exposed surfaces of aluminum windows shall be finished with anodic coating conforming to AA DAF-45: Architectural Class I, AA-M10-C22-A41, clear anodic coating, 0.7 mil or thicker, 215-R1 Natural Color. Finish shall be free of scratches and other blemishes.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA AAMA/NWWDA 101 I.S.2. The completed window installation shall be watertight in accordance with Section 07900 JOINT SEALING. Glazing shall be installed in accordance with requirements of this section and Section

08810 GLASS AND GLAZING.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glazing shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glazing surfaces.

-- End of Section --

SECTION 08700  
BUILDERS' HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	(1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA-01	(Effective thru Jun 1998) Directory of Certified Locks & Latches
BHMA-02	(Effective thru Jul 1997) Directory of Certified Door Closers
BHMA-03	(Effective thru Jul 1997) Directory of Certified Exit Devices
BHMA ANSI/BHMA A156.1	(1997) Butts and Hinges
BHMA ANSI/BHMA A156.2	(1996) Bored and Preassembled Locks and Latches
BHMA ANSI/BHMA A156.3	(1994) Exit Devices
BHMA ANSI/BHMA A156.4	(1992) Door Controls - Closers
BHMA ANSI/BHMA A156.5	(1992) Auxiliary Locks & Associated Products
BHMA ANSI/BHMA A156.6	(1994) Architectural Door Trim
BHMA ANSI/BHMA A156.7	(1988) Template Hinge Dimensions
BHMA ANSI/BHMA A156.8	(1994) Door Controls - Overhead Stops and Holders
BHMA ANSI/BHMA A156.13	(1994) Mortise Locks & Latches
BHMA ANSI/BHMA A156.16	(1989) Auxiliary Hardware
BHMA ANSI/BHMA A156.18	(1993) Materials and Finishes
BHMA ANSI/BHMA A156.20	(1996) Strap and Tee Hinges and Hasps
BHMA ANSI/BHMA A156.21	(1996) Thresholds

## DOOR AND HARDWARE INSTITUTE (DHI)

DHI-03 (1989) Keying Systems and Nomenclature

DHI-04 (1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames

DHI 05 (1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

DHI-A115.1G (1994) Installation Guide for Doors and Hardware

DHI A115-W (Varies) Wood Door Hardware Standards (Incl A115-W1 thru A115-W9)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1997; Errata 97-1) Life Safety Code

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Hardware and Accessories; GA.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, after approval of the detail drawings, and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

## SD-04 Drawings

Hardware Devices; GA.

Detail drawings for hardware devices for computerized keying systems, magnetic cards, keyless push button access control systems, and other electrical hardware devices showing complete wiring and schematic diagrams and other details required to demonstrate proper function of units.

## SD-07 Schedules

Hardware Schedule; GA.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule; GA.

Keying schedule developed in accordance with DHI-03, after the keying meeting with the user.

### SD-13 Certificates

Hardware and Accessories; FIO.

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA-01, BHMA-02 and BHMA-03 directories of certified products may be submitted in lieu of certificates.

#### 1.3 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

#### 1.5 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

#### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

#### 1.7 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided.

### PART 2 PRODUCTS

#### 2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

#### 2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA ANSI/BHMA A156.7.

## 2.3 HINGES

Hinges shall conform to BHMA ANSI/BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA ANSI/BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

### 2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

### 2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 101.

## 2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks, and all components thereof, including cylinders and removable cores, shall be the products of a single manufacturer. Lock fronts for double-acting doors shall be rounded. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes.

### 2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA ANSI/BHMA A156.13, operational Grade 1. Mortise type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

### 2.4.2 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA ANSI/BHMA A156.2, Grade 1. Bored type locks and latches for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

### 2.4.3 NOT USED

### 2.4.4 Auxiliary Locks and Associated Products

Bored and mortise dead locks and dead latches, narrow style dead locks and dead latches, rim latches, dead latches, and dead bolts, and electric strikes shall conform to BHMA ANSI/BHMA A156.5. Bolt and latch retraction shall be dead bolt style. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

### 2.4.5 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA ANSI/BHMA A156.5. Lock cylinder shall have not less than seven pins. Cylinders shall have key removable type cores. A grand master keying system shall be provided. Construction interchangeable cores shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, lockable exit devices, and padlocks shall accept same interchangeable cores.

### 2.4.6 NOT USED

### 2.4.7 Padlocks

Padlocks shall conform to ASTM F 883. Straps, tee hinges, and hasps shall conform to BHMA ANSI/BHMA A156.20.

#### 2.4.8 Push/Pull Latches

#### 2.4.9 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA ANSI/BHMA A156.2 or BHMA ANSI/BHMA A156.13, knobs, lever handles, roses, and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick. Knob diameter shall be 2-1/8 to 2-1/4 inches. Lever handles shall be of plain design with ends returned to no more than 1/2 inch from the door face.

### 2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA ANSI/BHMA A156.3, Grade 1.

#### 2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars shall be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons shall be cut to suit cylinders and operating trim.

#### 2.5.2 Door Coordinator

Door coordinator with carry bar shall be Type 21 and shall be provided for each pair of doors equipped with an overlapping astragal. The coordinator may be gravity operated and shall be capable of holding the active door of a pair open until the inactive door has preceded it in the closing cycle. When used as fire exit hardware, the coordinator and carry bar shall be listed or labeled by a nationally recognized independent testing laboratory.

### 2.6 NOT USED

### 2.7 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	3 change keys each lock.
Grand master keys:	2 total.
Control keys:	2 total.
Construction keys:	2 total.
Blank keys:	10 total.

The keys shall be furnished to the Contracting Officer arranged in a container in sets or subsets as scheduled.

### 2.8 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA ANSI/BHMA A156.4, Grade 1.

Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 lbf applied at the latch stile or exceed 5 lbf where low opening resistance is scheduled.

#### 2.8.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Standard Cover with options PT-4H, Size 1 or 2 through Size 6, and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

#### 2.9 DOOR CONTROLS - OVERHEAD HOLDERS

Door controls - overhead holders shall conform to BHMA ANSI/BHMA A156.8.

#### 2.10 NOT USED

#### 2.11 NOT USED

#### 2.12 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA ANSI/BHMA A156.6.

##### 2.12.1 Door Protection Plates

###### 2.12.1.1 NOT USED

###### 2.12.1.2 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. Height shall be 12 inches, except where the bottom rail is less than 12 inches the plate shall extend to within 1/2 inch of the panel mold or glass bead. Edges of metal plates shall be beveled.

###### 2.12.2 NOT USED

##### 2.12.3 Push Plates

###### 2.12.3.1 Combination Push-Pull Plates

Combination push-pull plates shall be Type J303, 0.050 inch thick minimum stainless steel beveled four edges.

###### 2.12.3.2 Flat Plates

Flat plates shall be Type J301 0.50 inch thick stainless steel, size 4 X 12". Edges of metal plates shall be beveled.

##### 2.12.4 Door Pulls and Push/Pull Units

###### 2.12.4.1 NOT USED

###### 2.12.4.2 NOT USED

###### 2.12.4.3 Door Pulls

Door pulls shall be Category J400 stainless steel of plain modern design. Pulls for hollow metal, mineral core wood or kalamein doors shall be Type J405 thru-bolted to Type J301 flat push plates.

## 2.13 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door holders and door stops shall conform to BHMA ANSI/BHMA A156.16. Lever extension flush bolts shall be Type L14081. Dust-proof strikes shall be Type L04011 for doors that are not fire rated.

## 2.14 MISCELLANEOUS

### 2.14.1 NOT USED

### 2.14.2 Metal Thresholds

Thresholds shall conform to BHMA ANSI/BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Thresholds for use with floor closers shall conform to BHMA ANSI/BHMA A156.4. Latching thresholds shall be of such height that the bottom of the door shall be 1/8 inch over the tread of the threshold and 1/8 inch below the top of the stop. Where required, thresholds shall be modified to receive projecting bolts of flush bolts, exit devices. Thresholds for doors accessible to the handicapped shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 1/2 inch. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

### 2.14.3 Rain Drips

Extruded aluminum, not less than 0.07 inch thick, painted. Door sill rain drips shall be 1-1/2 inches to 1-3/4 inches high by 5/8 inch projection. Overhead rain drips shall be approximately 1-1/2 inches high by 2-1/2 inches projection and shall extend 2 inches on either side of the door opening width.

### 2.14.4 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be clear (natural) anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

### 2.14.5 NOT USED

### 2.14.6 Key Control Storage System

Key control storage system shall conform to BHMA ANSI/BHMA A156.5, Type shall be properly labeled for key identification. Set up, identification labeling and location of the key control storage shall be as directed at the Predelivery Conference.

### 2.14.7 Door Stops

Wall stops, floor stops and combination stop and holders shall conform to BHMA ANSI/BHMA A156.16.

## 2.15 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed

to the weather in the finished work shall be of brass, bronze, or stainless steel. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws. Screws for the jamb leaf of half-mortise and full-surface hinges attached to structural steel frames shall be one-way or other approved tamperproof type.

## 2.16 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA ANSI/BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

## PART 3 EXECUTION

### 3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI 05, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-A115.1G or DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses.

#### 3.1.1 NOT USED

#### 3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

#### 3.1.3 Key Control Storage Systems

Key control storage system shall be furnished to the Contracting Officer.

#### 3.1.4 Kick Plates and Mop Plates

Kick plates shall be installed on the push side of single-acting doors and on both sides of double-acting doors. Mop plates shall be installed on the pull side of the single acting doors.

#### 3.1.5 Auxiliary Hardware

Lever extension flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. The bottom bolt shall operate into a dust-proof floor strike or threshold.

#### 3.1.6 Thresholds

Thresholds shall be secured with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inch thread engagement into the floor or anchoring device used.

## 3.1.7 Rain Drips

Door sill rain drips shall align with the bottom edge of the door.  
Overhead rain drips shall align with bottom edge of door frame rabbet.  
Drips shall be set in sealant and fastened with stainless steel screws.

## 3.1.8 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

## 3.2 NOT USED

## 3.3 FIELD QUALITY CONTROL

Supplier shall inspect the completed installation and certify that the hardware has been furnished and installed in accordance with the manufacturers' instructions and as specified. The inspection report shall identify any malfunctioning items and recommend adjustment or replacement as appropriate.

## 3.4 HARDWARE SETS

## INSPECTION BUILDING

## Hardware Set No. 1

Door Nos. 101A, 101C, 102A, 102C, 103A, 103C

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Exit Device	Type 3, Function 08 (Lever Handle) x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Cylinder	E59211A x US32D
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

## Hardware Set No. 2

Door No. 104A

3 Pr. Hinges	A5111 x US32D
1 Ea. Threshold	J32130 x 6'-0" W
2 Sets Weatherstrip	As Specified
1 Ea. Lockset	F40 x US32D (Kurlled Knob)
1 Ea. Flushbolt	L04161 x US32D
1 Ea. Footbolt	L01421 x US32D
1 Ea. Overhead Holder	C02511 x US32D
1 Ea. Closer W/Hold Open Arm	C02051 x US32D

NOTE: Active leaf latches and locks to inactive leaf. Provide closer on active leaf. Provide flushbolts on inactive leaf. Provide overhead holder on inactive leaf. Provide door coordinator as required.

NOTE: Inspection Building is Div. II, Class I Hazard Rating. All hardware shall meet explosion resistant requirements for Div. II, Class I Rating.

## RESIDUE TURN-IN BUILDING

## Hardware Set No. 1

Door Nos. 101A, 102A, 102B, 102C, 102F, 102G, 101B

1 1/2 Pr. Hinges	A5111 x US32D
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1 Ea. Exit Device	Type 3, Function 08 (Lever Handle) x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Cylinder	E59211A x US32D
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

Hardware Set No. 2

Door No. 105A

3 Pr. Hinges	A5111 x US32D
1 Ea. Threshold	J32130 x 6'-0" W
2 Sets Weatherstrip	As Specified
1 Ea. Lockset	F40 x US32D (Knurled Knob)
1 Ea. Flushbolt	L04161 x US32D
1 Ea. Footbolt	L01421 x US32D
1 Ea. Overhead Holder	C02511 x US32D
1 Ea. Closer W/Hold Open Arm	C02051 x US32D

NOTE: Active leaf latches and locks to inactive leaf. Provide closer on active leaf. Provide flushbolts on inactive leaf. Provide overhead holder on inactive leaf. Provide door coordinator as required.

Hardware Set No. 3

Door No. 104A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Kickplate	J102 x 10" X US32D
1 Ea. Pushplate	J301 x US32D
1 Ea. Pull	J401 x US32D
1 Ea. Dead Lock	E0221 x US32D
1 Ea. Wall Bumper	L02251 x US32D

Hardware Set No. 4

Door No. 103A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Wall Bumper	L02251 x US32D
1 Ea. Lockset	F42 x US32D

Hardware Set No. 5

Hinged Caging Doors

Provide 1 1/2 pair butt hinges riveted or welded to door frame and mortise type cylinder lockset with lever handles. Provide lockset with function F42 and lever handles. Align bottom of door with bottom of adjacent panels.

OPERATIONS BUILDING

Hardware Set No. 1

Door Nos. 101A, 102A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Wall Bumper	L02251 x US32D
1 Ea. Lockset	F42 x US32D

Hardware Set No. 2

## Door No. 107A, 106A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Kickplate	J102 x 10" X US32D
1 Ea. Pushplate	J301 x US32D
1 Ea. Pull	J401 x US32D
1 Ea. Dead Lock	E0221 x US32D
1 Ea. Wall Bumper	L02251 x US32D

## Hardware Set No. 3

## Door No. 105A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Threshold	J32130 x 3'-0" W
1 Set Weatherstrip	As Specified
1 Ea. Lockset	F40 x US32D (Knurled Knob)
1 Ea. Closer W/Hold Open Arm	C02051 x US32D

## Hardware Set No. 4

## Door No. 104A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Lockset	F42 x US32D

## Hardware Set No. 5

## Door Nos. 103A, 103B

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Exit Device	Type 3, Function 08 (Lever Handle) x US32D
1 Ea. Closer	C02011 x US32D
1 Ea. Cylinder	E59211A x US32D
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

## PUMPHOUSE

## Hardware Set No. 1

## Door No. 101A

1 1/2 Pr. Hinges	A5111 x US32D
1 Ea. Closer W/Hold Open Arm	C02061 x US32D
1 Ea. Lockset	F40 x US32D (Knurled Knob)
1 Set Weatherstrip	As Specified
1 Ea. Threshold	J32130 x 3'-0" W

-- End of Section --

## SECTION 08840

## PLASTIC GLAZING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 669 (1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash

ASTM C 920 (1995) Elastomeric Joint Sealants

## 1.2 GENERAL REQUIREMENTS

Plastic glazing shall be provided in the locations indicated. Glazing may be performed in the shop or in the field using plastic sheets of the thickness specified.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

## SD-01 Data

Glazing Materials; GA. Cleaning; FIO.

Data composed of catalog cuts, brochures, cleaning directions, and compatible cleaning agents.

## SD-06 Instructions

Installation; FIO.

Manufacturer's installation instructions.

## SD-13 Certificates

Glazing Materials; GA.

Certificates stating that the plastic sheets and glazing material meet the specified requirements.

## SD-14 Samples

Plastic Sheets; GA. Glazing Compound; GA. Glazing Tape; GA. Sealant; GA.

Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 inches.

#### 1.4 DELIVERY AND STORAGE

Glazing compounds, sealants and primers shall be delivered to the site in the manufacturer's unopened containers. Plastic sheets shall be stored in safe, dry locations and shall not be unpacked until needed for installation.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Plastic Sheets

###### 2.1.1.1 NOT USED

###### 2.1.1.2 Polycarbonate Plastic Sheets

Polycarbonate structured plastic sheets shall conform to ANSI Z97.1, clear and smooth on both sides, ultraviolet stabilized, scratch resistant, 1 inch heavy-duty insulated triple wall configuration for exterior glazing and 1/4" regular configuration for interior glazing.

###### 2.1.2 Glazing Compound

Nonhardening glazing compound shall conform to ASTM C 669, gray or neutral color for glazing in wood, steel, or color finished aluminum, and aluminum color for glazing in natural colored aluminum.

###### 2.1.3 Glazing Tape

Glazing tape shall be fully-cured synthetic rubber, or plastic composition; and shall be unreinforced, 100 percent solid, resilient, nonsagging, nonstaining, and noncrazing. The tape shall be pressure sensitive. The tape shall be capable of sealing out moisture, air, and dust when compressed to the extent recommended by the glazing tape manufacturer for the extensibility requirements of the joint. The tape shall be furnished in the proper width and depth for the particular application in order to obtain the required degree of compression when installed in the joint. The tape shall withstand temperatures of minus 40 degrees F up to 160 degrees F without bleeding, cracking, flowing, or showing signs of deterioration. Tape color shall match adjacent door or window frames.

###### 2.1.4 Sealant

Sealant shall conform to ASTM C 920, Grade NS, Class 25; Use G. Sealant shall be gray or neutral color for glazing in wood, steel, or color finished aluminum, and aluminum color for glazing in natural color aluminum.

###### 2.1.5 Sealant Backstop Material

Sealant backstop shall be a material that will not adversely affect or bond with sealant. Shape and dimensions shall be as recommended by the plastic sheet manufacturer for the particular application.

###### 2.1.6 Sealant Primer

Sealant primer shall be as recommended by the sealant manufacturer.

### 2.1.7 Glazing Accessories

Glazing accessories shall be as required to supplement the items to be glazed including glazing points and spacer shims. Ferrous metal accessories shall have a finish that will not stain or corrode while in service. Spacer shims shall be of material and of dimensions recommended by the plastic sheet manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Glazing shall be performed in accordance with the approved installation instructions of the plastic sheet manufacturer.

### 3.2 CLEANING

The plastic surfaces shall be clean and free of smears, spatters, scratches, and other defacement at the time the work is accepted. Cleaning shall be in accordance with the plastic sheet manufacturer's recommendation.

-- End of Section --

SECTION 09250  
GYPSUM WALLBOARD

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580/A 580M	(1995a) Stainless Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM B 164	(1993) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM C 36	(1997) Gypsum Wallboard
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 557	(1993a) Adhesive for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630/C 630M	(1996a) Water-Resistant Gypsum Backing Board
ASTM C 645	(1996a) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 840	(1996) Application and Finishing of Gypsum Board
ASTM C 931/C 931M	(1995a) Exterior Gypsum Soffit Board
ASTM C 1002	(1996a) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM C 1047	(1995) Accessories for Gypsum Wallboard and Gypsum Veneer Base

## GYPSUM ASSOCIATION (GA)

GA 216	(1996) Application and Finishing of Gypsum Board
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## 1.2 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Steel Framing; GA. Control Joints; GA.

Drawings and installation details for ceiling framing, furring, special wall framing, and framed openings in walls and ceilings.

#### SD-13 Certificates

Gypsum Wallboard; GA. Water-Resistant Gypsum Board; GA. Exterior Gypsum Soffit Board; GA. Steel Framing; GA.

Certificates stating that the steel framing and gypsum wallboard meet the specified requirements.

### 1.4 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

### 1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored off the ground in a weathertight structure for protection. Gypsum boards shall be stacked flat, off floor and supported to prevent sagging and warpage. Adhesives and joint materials shall be stored in accordance with manufacturer's printed instructions. Damaged or deteriorated materials shall be removed from jobsite.

### 1.6 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840. During the application of gypsum board without adhesive, a room temperature of not less than 40 degrees F shall be maintained. During the application of gypsum board with adhesive, a room temperature of not less than 50 degrees F shall be maintained for 48 hours prior to application and continuously afterwards until completely dry. Building spaces shall be ventilated to remove water not required for drying joint treatment materials. Drafts shall be avoided during dry hot weather to prevent materials from drying too rapidly.

## PART 2 MATERIALS

### 2.1 NON-LOADBEARING STUD WALLS

#### 2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll formed steel with minimum uncoated design thickness of 20 Ga. made from G40 hot-dip galvanized coated sheet.

#### 2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped with minimum 1 5/8 inch flanges, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

## 2.2 NOT USED

## 2.3 SUSPENDED CEILING FRAMING

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown.

The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 0.0548 in thick cold-rolled steel, 1-1/2 x 3/4 inch. Furring members shall be formed from cold-rolled steel, 7/8 x 2-9/16 inch. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

## 2.4 GYPSUM BOARD

Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length. Gypsum board thickness shall be as shown.

## 2.4.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36, and shall be 48 inches wide.

## 2.4.2 NOT USED

## 2.4.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall conform to ASTM C 630/C 630M, regular, with water-resistant paper faces, paintable surfaces, and shall be 48 inch width and maximum permissible length.

## 2.4.4 NOT USED

## 2.4.5 NOT USED

## 2.4.6 NOT USED

## 2.4.7 Exterior Gypsum Soffit Board

Exterior gypsum soffit board shall conform to ASTM C 931/C 931M, regular, 48 inches wide.

## 2.5 TRIM, MOLDINGS, AND ACCESSORIES

## 2.5.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads, and shall be compatible with tape and substrate.

## 2.5.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use as a finishing compound for gypsum board.

## 2.5.3 All-Purpose Compound

All-purpose compound shall be specifically formulated and manufactured to use as a taping and finishing compound, and shall be compatible with tape and substrate.

## 2.5.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

#### 2.5.5 Trim, Control Joints, Beads, Stops and Nosings

Items used to protect edges, corners, and to provide architectural features shall be in accordance with ASTM C 1047.

### 2.6 FASTENINGS AND ADHESIVES

#### 2.6.1 Nails

Nails shall conform to ASTM C 514. Nails shall be hard-drawn low or medium-low carbon steel, suitable for intended use.

#### 2.6.2 Screws

Screws shall conform to ASTM C 1002. Screws shall be self-drilling and self-tapping steel, Type G for gypsum board to gypsum board and Type S for wood or light-gauge steel framing.

#### 2.6.3 Adhesives

Adhesives shall conform to ASTM C 557. For securing gypsum board to metal framing, adhesive shall be as recommended by gypsum board manufacturer.

#### 2.6.4 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853 or flat iron or steel straps, at least 3/32 x 7/8 inch size, coated with zinc, cadmium, or rust-inhibiting paint.

#### 2.6.5 Wire and Clip Type Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580/A 580M, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B 164, annealed condition except that walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

##### 2.6.5.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 SWG.

##### 2.6.5.2 Clips

Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 1/8 inch thick or shall be hairpin clip, formed of wire not less than 0.01620 inch nominal diameter. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

### PART 3 EXECUTION

#### 3.1 INTERIOR WALL FRAMING

Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment with spacings not to exceed the maximum spacings indicated on drawings. Runners shall be aligned accurately at the floor and ceiling and securely anchored.

### 3.1.1 Wall Openings

The framing system shall provide for the installation and anchorage of the required subframes or finish frames for wall openings at doors, pass-through openings, and access panels. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings of more than 30 inches wide. Studs at openings shall be 0.0329 in minimum bare metal thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together with screws and secured to floor and overhead runners. Two studs shall be used for framing solid-core doors, doors over 36 inches wide and extra-heavy doors such as X-ray room doors.

### 3.1.2 Wall Control Joints

Control joints for expansion and contraction in the walls shall be constructed with double studs installed 1/2 inch apart in interior walls or wall furrings where indicated on drawings. Control joint spacing shall not exceed 30 feet. Ceiling-height door frames may be used as vertical control joints. Door frames of less than ceiling height may be used as control joints only if standard control joints extend to ceiling from both corners of top of door frame.

### 3.1.3 Blocking

Blocking shall be provided as necessary for mounted equipment. Blocking shall be wood and shall be cut to fit between framing members. Blocking shall be rigidly anchored to the framing members. Under no circumstances will accessories or other wall mounted equipment be anchored directly to gypsum wallboard.

### 3.2 NOT USED

### 3.3 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754.

#### 3.3.1 Hangers

Hangers shall be spaced not more than 48 inches along runner channels and 36 inches in the other direction or 42 inches in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 6 inches from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

#### 3.3.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 6 inches of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 12 inches with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

#### 3.3.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports

at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 2 inches of parallel walls and beams, and shall be cut 1/2 inch short of abutting walls.

### 3.3.4 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 1-1/2 inch main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

### 3.3.5 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

### 3.3.6 Control Joints

Ceiling control joints for expansion and contraction shall be located where indicated on drawings. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

#### 3.3.6.1 Interior Ceilings With Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 50 feet in either direction nor more than 2500 square feet.

#### 3.3.6.2 Interior Ceilings Without Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 30 feet in either direction nor more than 900 square feet.

#### 3.3.6.3 Exterior Ceilings

Control joints shall be installed so the linear dimensions between control joints shall not exceed 30 feet in either direction nor more than 900 square feet.

### 3.4 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840 and GA 216 and as specified. Paragraph 17.3.1 GENERAL of ASTM C 840 which permits usage of water resistant gypsum board as a base for adhesive application of ceramic or plastic tile on ceilings, does not apply. Edges and ends of gypsum boards shall be cut to obtain neat fitting joints. End joints of adjoining boards shall be staggered, and shall be staggered on opposite sides of wall. Boards shall be applied with moderate contact without forcing in place. Holes for pipes, fixtures or other small openings shall be cut with a tool which will provide a neat fit. Screws shall be driven so that the heads are slightly below the plane of paper face. Fracturing the paper face or damaging the core shall be avoided. Trim shall be installed at external and internal angles formed by the intersecting gypsum board surfaces with other surfaces. Corner beads shall be installed to vertical and horizontal corners in accordance with manufacturer's published instructions.

#### 3.4.1 NOT USED

#### 3.4.2 NOT USED

### 3.4.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall be installed at the locations indicated.

### 3.5 TRIM, MOLDINGS, AND ACCESSORIES INSTALLATION

Trim, moldings and accessories shall be installed in accordance with GA 216.

### 3.6 TAPING AND FINISHING

Gypsum board taping and finishing shall be performed in accordance with ASTM C 840. Boards shall be kept free of dirt, oil and other foreign matter that could cause a lack of bond. Screw heads, dents, gouges, and cut-outs shall be filled with joint compound and sanded. Accessories at exposed joints, edges, corners, openings, and similar locations shall be taped, floated with joint compound, and sanded to produce surfaces ready for gypsum board finishes.

### 3.7 NOT USED

### 3.8 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board smooth, uniform in appearance, and ready to receive finish as specified.

-- End of Section --

## SECTION 09310

## CERAMIC TILE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.4	(1992) Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units
ANSI A118.3	(1992) Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive
ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units
ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI A137.1	(1988) Ceramic Tile

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 241	(1990) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products

ASTM C 648	(1984; R 1994) Breaking Strength of Ceramic Tile
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1984; R 1990) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

## MARBLE INSTITUTE OF AMERICA (MIA)

MIA-01	(1991) Design Manual IV Dimensional Stone
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## TILE COUNCIL OF AMERICA (TCA)

TCA-01	(1997) Handbook for Ceramic Tile Installation
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Tile; GA. Mortar, Grout, and Adhesive; GA.

Manufacturer's catalog data.

## SD-06 Instructions

Tile; FIO. Mortar and Grout; FIO.

Manufacturers preprinted installation and cleaning instructions.

## SD-13 Certificates

Tile; GA. Mortar, Grout, and Adhesive; GA.

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

## SD-14 Samples

Tile; GA. Accessories; GA. Marble Thresholds; GA.

Samples of sufficient size to show color range, pattern, type and joints.

## 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

## 1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient

temperature is at least 50 degrees F and rising. Temperature shall be maintained above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 250 lbs for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373.

Floor tile shall have a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class IV-Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic.

##### 2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed with cushion edges. Tile size shall be 2 x 2 inches. Color shall be as indicated in the interior finish key.

##### 2.1.2 NOT USED

##### 2.1.3 NOT USED

##### 2.1.4 Glazed Wall Tile

Glazed wall tile and trim shall be cushion edged with bright glaze. Tile shall be 4-1/4 x 4-1/4 inches. Color shall be as indicated on the interior finish key.

##### 2.1.5 Accessories

Where required, accessories shall be the built-in type of the same materials and finish as the wall tile.

#### 2.2 NOT USED

#### 2.3 WATER

Water shall be potable.

#### 2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

##### 2.4.1 NOT USED

##### 2.4.2 NOT USED

##### 2.4.3 Latex-Portland Cement Mortar

ANSI A118.4.

2.4.4 Ceramic Tile Grout

ANSI A118.6; sand portland cement grout, dry-set grout.

2.4.5 Organic Adhesive

ANSI A136.1, Type I.

2.4.6 Epoxy Resin Grout

ANSI A118.3.

2.4.7 NOT USED

2.4.8 Cementitious Backer Board

Cementitious backer units shall comply with ANSI A118.9.

2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA-01. Marble shall have a fine sand-rubbed finish and shall be gray in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex portland cement mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA-01, method W223, and W242.

3.3.1 Workable or Cured Mortar Bed

Tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. A 4 mil polyethylene membrane, metal lath, and scratch coat shall also be installed. Workable mortar bed, materials, and installation of tile shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

### 3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Dry-set or Latex-portland cement shall be used to install tile in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

### 3.3.3 Organic Adhesive

Organic adhesive installation of ceramic tile shall conform to ANSI A108.4.

## 3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA-01, method F113 and G115. Shower receptors shall be installed in accordance with TCA-01, method B414 and B415.

### 3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B. Joints between quarry tile shall be between 1/4 inch and 3/8 inch in width and shall be uniform in width.

### 3.4.2 Dry-Set and Latex-Portland Cement

Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

### 3.4.3 NOT USED

### 3.4.4 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

### 3.4.5 NOT USED

### 3.4.6 NOT USED

### 3.4.7 Cementitious Backer Board

Cementitious backer units shall be installed in accordance with ANSI A108.11. Fasteners shall be type designed for cement board application.

## 3.5 NOT USED

## 3.6 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 1/4 inch in width and shall be grouted full as specified for ceramic tile.

## 3.7 NOT USED

## 3.8 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07900 JOINT SEALING.

### 3.8.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

### 3.8.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

### 3.9 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

## SECTION 09510

## ACOUSTICAL CEILINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(1995) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 1264	(1990) Standard Classification for Acoustical Ceiling Products
ASTM E 1414	(1991a) Standard Test for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

## 1.2 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. . The location and extent of acoustical treatment shall be as shown on the drawings.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Acoustical Ceiling System; GA.

Manufacturer's descriptive data, catalog cuts, and installation instructions.

## SD-04 Drawings

Acoustical Ceiling System; GA.

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

## SD-09 Reports

Ceiling Attenuation Class and Test; FIO.

Reports by an independent testing laboratory attesting that acoustical

ceiling systems meet specified sound transmission requirements.

#### SD-14 Samples

Acoustical Units; GA.

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

### 1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

### 1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

### 1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 25 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

## PART 2 PRODUCTS

### 2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

#### 2.1.1 Units for Exposed-Grid System

Type: III (mineral fiber with painted finish). Type III acoustical units shall have a minimum recycled material content of 18 percent.

Minimum NRC: 0.55 when tested on mounting No. E-400

Pattern: C.

Nominal size: 24 by 24 inches.

Edge detail: Trimmed and butt.

Finish: Factory-applied standard finish.

Minimum LR coefficient: 0.70.

Minimum CAC: 40.

## 2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than 15/16 inch. Inside and outside corner caps shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length.

## 2.3 HANGERS

Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

## 2.4 ACCESS PANELS

Access panels shall match adjacent acoustical units and shall be designed and equipped with suitable framing and fastenings for removal and replacement without damage. Panel shall be not less than 12 by 12 inches or more than 12 by 24 inches. An identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, shall be attached near one corner on the face of each access panel.

## 2.5 NOT USED

## 2.6 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

## 2.7 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as indicated on the interior room finish key..

## 2.8 CEILING ATTENUATION CLASS AND TEST

Ceiling attenuation class (CAC) range of acoustical units, when required, shall be determined in accordance with ASTM E 1414. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project. System shall be tested with all acoustical units installed.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an

object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

### 3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

#### 3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes.

#### 3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

### 3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Wall molding shall be secured not more than 3 inches from ends of each length and not more than 16 inches on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

### 3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

## 3.2 CEILING ACCESS PANELS

Ceiling access panels shall be located directly under the items which require access.

## 3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

-- End of Section --

SECTION 09650  
RESILIENT FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4078 (1992; R 1996) Water Emulsion Floor Polish  
ASTM F 1066 (1995a) Vinyl Composition Floor Tile

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Resilient Flooring and Accessories; GA.

Manufacturer's descriptive data and installation instructions including cleaning and maintenance instructions.

SD-09 Reports

Resilient Flooring and Accessories; FIO.

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified.

SD-14 Samples

Resilient Flooring and Accessories; GA.

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 2-1/2 x 4 inches.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 70 degrees F for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 70 degrees F and below 100 degrees F for 2 days before application, during application and 2 days after application. A minimum temperature of 55 degrees F shall be maintained thereafter.

### 1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

### 1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 25 tiles for each 1000 tiles installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 20 linear feet of each color shall be furnished.

## PART 2 PRODUCTS

### 2.1 VINYL-COMPOSITION TILE

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, (through pattern tile), Composition 1, asbestos-free, and shall be 12 inches square and 1/8 inch thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

### 2.2 NOT USED

### 2.3 NOT USED

### 2.4 NOT USED

### 2.5 NOT USED

### 2.6 RESILIENT BASE

Base shall be manufacturers standard rubber. Base shall be 4 inches high and a minimum 1/8 inch thick. Preformed outside and inside corners shall be furnished.

### 2.7 NOT USED

### 2.8 NOT USED

### 2.9 TRANSITION STRIP

A rubber transition strip tapered to meet abutting material shall be provided. Color shall match rubber wall base.

### 2.10 ADHESIVE

Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.

### 2.11 POLISH

Polish shall conform to ASTM D 4078.

#### 2.12 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07900 JOINT SEALING.

#### 2.13 MANUFACTURER'S COLOR AND TEXTURE

Color and texture shall be as indicated in the interior finish key.

### PART 3 EXECUTION

#### 3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

#### 3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

#### 3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

#### 3.4 INSTALLATION OF VINYL-COMPOSITION TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

#### 3.5 NOT USED

#### 3.6 NOT USED

#### 3.7 NOT USED

#### 3.8 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk.

#### 3.9 NOT USED

## 3.10 NOT USED

## 3.11 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. After installation, flooring shall be washed with a cleaning solution, rinsed thoroughly with clear cold water, and, except for raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile, given two coats of polish in accordance with manufacturers written instructions. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine. Raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile shall be cleaned and maintained as recommended by the manufacturer.

## 3.12 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled shall be removed and replaced.

-- End of Section --

## SECTION 09680

## CARPET

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC TM 16	(1993) Test Method: Colorfastness to Light
AATCC TM 134	(1991) Test Method: Electrostatic Propensity of Carpets
AATCC TM 165	(1993) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method
AATCC TM 174	(1993) Test Method: Antimicrobial Activity Assessment of Carpet

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 1423	(1992) Twist in Yarns by the Direct-Counting Method
ASTM D 3278	(1996) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E 648	(1997) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

## CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1996) Commercial Carpet Installation Standard
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## CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1630	Standard for the Surface Flammability of Carpet and Rugs (FF 1-70)
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## GERMANY INSTITUTE FOR STANDARDIZATION (DEUTSCHES INSTITUT FÜR NORMUNG) (DIN)

DIN 54318	(1986) Machine-Made Textile Floor Coverings; Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions; Identical with ISO 2551 Edition 1981
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Carpet and Accessories; GA.

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

SD-04 Drawings

Installation; GA.

Six copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-06 Instructions

Carpet and Accessories; FIO.

Six copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

SD-09 Reports

Moisture and Alkalinity Tests; FIO.

Six copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-13 Certificates

Carpet and Accessories; FIO.

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

SD-14 Samples

Carpet and Accessories; GA.

- a. Carpet: Two "Production Quality" samples 27 x 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.
- b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.
- c. Special Treatment Materials: Two samples showing system and installation method.

SD-19 Operation and Maintenance Manuals

Carpet and Accessories; GA.

Six copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning

methods, and cleaning cycles.

### 1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 60 degrees F for 2 days prior to installation.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 60 degrees F for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 55 degrees F shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

### 1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of uncut carpet tiles shall be provided for future maintenance. A minimum of 10 percent of total square yards of each carpet type, pattern, and color shall be provided.

## PART 2 PRODUCTS

### 2.1 CARPET TYPE

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance.

#### 2.1.1 Physical Characteristics

Carpet shall comply with the following:

- a. Carpet Construction: Bonded.
- b. Type: Modular tile 18 x 18 inches square with 0.15 percent growth/shrink rate in accordance with DIN 54318.
- c. Pile Type: Level-loop.
- d. Pile Fiber: 75% commercial solution dyed nylon continuous filament, 25% Dupont Antron Legacy.
- e. Pile or Wire Height: Minimum 0.117 inch in accordance with ASTM D

418.

- f. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.
- g. Gauge or Pitch: Minimum 1/13 inch in accordance with ASTM D 418.
- h. Finished Pile Yarn Weight: Minimum 20 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.
- i. Pile Density: Minimum 6154.
- j. Dye Method:

Solution dyed.

- k. Backing Materials: Primary backing materials shall be synthetic hardback. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.

#### 2.1.2 Performance Requirements

- a. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC TM 134.
- b. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648.
- c. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 9 pound average force for loop pile.
- d. Additional Performance Characteristics:
  - (1) Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC TM 174, Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.
- e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC TM 165 and shall have a minimum rating of step 4 on the AATCC Color Transference Chart for all colors.
- f. Colorfastness to Light: Colorfastness to light shall comply with AATCC TM 16 and shall have a minimum 4 grey scale rating after 40 hours.
- g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 2.5 lb./inch

#### 2.2 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as recommended by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer. Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 140 degrees F in accordance with ASTM D 3278.

## 2.3 MOLDING

Rubber vinyl molding shall be heavy-duty and designed for the type of carpet being installed. Floor flange shall be a minimum 2 inches wide. Color shall match rubber coved base.

## 2.4 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

## 2.5 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be as indicated in the interior finish key.

# PART 3 EXECUTION

## 3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

## 3.2 MOISTURE AND ALKALINITY TEST

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104. The moisture content shall not exceed a hygrometer reading of 65 percent.

## 3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

## 3.4 INSTALLATION

Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding. Installation shall be in accordance with the molding manufacturer's instructions.

### 3.4.1 NOT USED

### 3.4.2 Modular Tile Installation

Modular tiles shall be installed with release adhesive and shall be snugly jointed together. Tiles shall be laid in the same direction with accessibility to the subfloor where required.

## 3.5 CLEANING AND PROTECTION

### 3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

### 3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

### 3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total, shall be provided. Non-retained scraps shall be removed from site.

-- End of Section --

SECTION 09900  
PAINTING, GENERAL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-02 (1996) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150 (1996) Portland Cement  
ASTM D 4258 (1988; R 1992) Surface Cleaning Concrete for Coating

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500 (Rev A) Sealer, Surface (Latex Block Filler)  
CID A-A-1632 (Basic) Varnish, Asphalt  
CID A-A-2246 (Rev A) Paint, Latex (Gloss, Interior)  
CID A-A-2247 (Basic) Paint, Latex (Semigloss, Interior)  
CID A-A-2248 (Basic) Paint, Latex, (Flat, Interior)  
CID A-A-2867 (Basic) Coating, Polyurethane, Single Component Moisture Cure, Aliphatic  
CID A-A-2962 (Basic) Enamel, Alkyd  
CID A-A-2994 (Basic) Primer Coating, Interior, for Walls and Wood

## FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784 (Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 5 (1995) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint  
SSPC Paint 18 (1991) Chlorinated Rubber Intermediate Coat Paint  
SSPC Paint 23 (1982) Latex Primer for Steel surfaces  
SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead)

and Chromate Pigments)

SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Paint; GA.

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular batch is 50 gallons or less.

### SD-06 Instructions

Mixing and Thinning; FIO. Application; GA.

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings.

### SD-09 Reports

Paint; FIO.

A statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 50 gallons:

- a. A test report showing that the proposed batch to be used meets specified requirements:
- b. A test report showing that a previous batch of the same formulation as the batch to be used met specified requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per gallon, viscosity, fineness of grind, drying time, color, and gloss.

### SD-13 Certificates

Lead; FIO. Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead by weight of the total nonvolatile. Certificate stating that paints proposed for use meet Federal VOC regulations and those of the of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

### SD-14 Samples

Paint; GA.

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1 quart sample of each color and batch, except for quantities of 50 gallons or less, shall be taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.

### 1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons.

Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

### 1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

### 1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned, epoxy, and moisture-curing polyurethane coatings.

Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F. Epoxy, and moisture-curing polyurethane coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer. Moisture-curing polyurethane shall not be applied when the relative humidity is below 30 percent.

### 1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

#### 1.6.1 Worker Exposures

Exposure of workers to hazardous chemical substances shall not exceed limits established by ACGIH-02, or as required by a more stringent applicable regulation.

#### 1.6.2 Toxic Compounds

Toxic products having ineffective physiological warning properties, such as

no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

#### 1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MDSS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

#### 1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

### PART 2 PRODUCTS

#### 2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the requirements listed in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended formulation, usage and color to that specified may be used. Additional requirements are as follows:

##### 2.1.1 Colors and Tints

Colors shall be as selected from manufacturer's standard colors, as indicated. Manufacturer's standard color is for identification of color only. Tinting of epoxy paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

##### 2.1.2 NOT USED

##### 2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

##### 2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

##### 2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

### PART 3 EXECUTION

#### 3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

### 3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

#### 3.2.1 Concrete, Stucco and Masonry Surfaces

Concrete, stucco and masonry surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Surfaces shall be cleaned in accordance with ASTM D 4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat.

#### 3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

#### 3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1.

#### 3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a cloth, or vacuum-cleaning prior to application of the first-coat material. A damp cloth or sponge may be used if paint will be water-based.

#### 3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

### 3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not

relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

#### 3.3.1 Cement-Emulsion Filler Coat

Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

#### 3.3.2 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

### 3.4 APPLICATION

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

#### 3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

#### 3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

#### 3.4.3 First Coat

The first coat on plaster, gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall

be wiped off after each application. The first coat on both faces of wood doors shall be applied at essentially the same time. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around. Each varnish coat shall be sanded lightly prior to application of subsequent coats.

#### 3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

#### 3.4.5 Stains

Stain shall be applied at the rate specified in the manufacturer's printed directions. Oil-type stain shall be applied by brushing with the grain for the full length of the board or course of siding.

#### 3.4.6 Fillers

Concrete and masonry surface voids shall be filled; however, surface irregularities need not be completely filled. The dried filler shall be uniform and free of pinholes. Filler shall not be applied over caulking compound.

##### 3.4.6.1 Cement-Emulsion Filler

Immediately before filler application, surfaces shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 85 degrees F, cement-emulsion filler surfaces shall be dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

##### 3.4.6.2 Latex Filler

Latex filler, CID A-A-1500, shall be applied according to the manufacturer's instructions. Surface voids shall be filled and excess filler shall be removed from the surface with a rubber squeegee. The filler shall be allowed to dry the length of time specified by the manufacturer prior to applying successive coats of paint.

#### 3.4.7 NOT USED

#### 3.4.8 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 40 foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable) WATER	Green	White	POTABLE
Fire protection water WATER	Red	White	FIRE PR.
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Yellow	Black	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Yellow	Black	COMP. AIR
Natural gas	Blue	White	NAT. GAS
Freon	Blue	White	FREON
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STM.
Condensate	Yellow	Black	COND.

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

3.6 MISCELLANEOUS PAINTING

3.6.1 Lettering

Lettering shall be provided as scheduled on the drawings, shall be block type, and shall be black enamel. Samples shall be approved before application.

3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

3.8 NOT USED

3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by -----or----- between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Concrete masonry units.	Cement-emulsion filler	FS TT-E-2784 Type III	None
	CID A-A-1500	FS TT-E-2784 Type III	None
	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None

NOTE: Cement-emulsion filler coat shall be acrylic-based and shall consist of the following ingredients in the proportion stated: white portland cement, ASTM C 150, Type I, 16.5 pounds; aggregate 33.5 pounds; mixing liquid, factory-prepared acrylic containing 46 to 47 percent solids, 0.75 gallon; potable water 1.0 gallon maximum; exterior emulsion paint, FS TT-E-2784 Type III 1.0 gallon. Aggregate shall consist of Washed silica sand of the following gradation:

<u>U.S. Sieve Size</u>	<u>Percent Sand (by Weight) Passing Individual Sieve</u>
0.850 mm (20)	100
0.600 mm (30)	95 - 100
0.300 mm (50)	30 - 65
0.150 mm (100)	0 - 10
0.075 mm (200)	0 - 1

Concrete, unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None
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EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Concrete: walls 18 and bottom of swimming pools.	SSPC Paint 18  thin with 1 part of approved thinner to 4 parts of paint by volume	SSPC Paint 18	SSPC Paint
Ferrous metal unless otherwise	SSPC Paint 5  Grade C	CID A-A-2962 Type I specified  Grade C	CID A-A-2962 Type 1
	SSPC Paint 25	CID A-A-2962 Type I Grade C	CID A-A-2962 Type 1 Grade C
	SSPC Paint 23	FS TT-E-2784 Type I	FS TT-E-2784 Type I
Galvanized metal.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	FS TT-E-2784 Type III
Aluminum aluminum-alloy,  and other non- ferrous metal (non-galvanized)	CID A-A-2867  FS TT-E-2784 Type III	CID A-A-2867  FS TT-E-2784 Type III	None  FS TT-E-2784 Type III

INTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>	
Gypsum board, concrete, and concrete masonry units not requiring a smooth finish, unless otherwise specified.	CID A-A-2994 Type II	CID A-A-2246	None	
		-----or-----		
		CID A-A-2247	None	
		-----or-----		
		CID A-A-2248	None	
Concrete masonry units requiring a smooth finish	CID A-A-1500	CID A-A-2994 Type II	CID A-A-2246	
			-----or-----	
			CID A-A-2247	
			-----or-----	
			CID A-A-2248	
Gypsum board: in shower areas, and areas requiring a high degree of sanitation, unless otherwise specified.	CID A-A-2994 Type II	FS TT-E-2784	None	
Concrete masonry units, and gypsum board: for walls in heavy traffic areas.	CID A-A-1500	CID A-A-2994 Type II	CID A-A-2246	
			-----or-----	
			CID A-A-2247	
Ferrous Metal unless otherwise specified	SSPC Paint 25	CID A-A-2962 Type I	CID A-A-2962 Type I	
			Grade C	Grade C
	SSPC Paint 23	FS TT-E-2784 Type I	FS TT-E-2784 Type I	
	CID A-A-2867	CID A-A-2867	None	
Aluminum and aluminum alloy	CID A-A-2867	CID A-A-2867	None	

unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type I	FS TT-E-2784 Type I
Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces:	CID A-A-1632	None	None
Ferrous metal factory-primed mechanical and electrical equipment.	Two coats of paint as recommended by the equipment manufacturer		None
Galvanized metal:	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None
	SSPC Paint 5	CID A-A-2962 Type I Grade C	CID A-A-2962 Type I Grade C
	SSPC Paint 25	CID A-A-2962 Type I Grade C	CID A-A-2962 Type I Grade C
	SSPC Paint 23	FS TT-E-2784	FS TT-E-2784
Ferrous Metal: Convector enclosures, electrical conduit runs: metallic tubing uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets, in areas having painted adjacent surfaces.	SSPC Paint 23	None	None
Aluminum and Galvanized Surface Metal: Convector enclosures, electrical conduit runs metallic tubing uninsulated	FS TT-E-2784	CID A-A-2246 -----or----- CID A-A-2247 -----or----- CID A-A-2248	CID A-A-2246 -----or----- CID A-A-2247 -----or----- CID A-A-2248

ducts and pipes,  
pipe hangers,  
louvers, grilles,  
and air outlets,  
in areas having  
painted adjacent  
surfaces.

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-- End of Section --

SECTION 10160  
TOILET PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-60003 Partitions, Toilet, Complete

1.2 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The partition system shall be provided by a single manufacturer and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Toilet Partition System; GA.

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Drawings

Toilet Partition System; GA.

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-14 Samples

Toilet Partition System; GA.

Manufacturer's standard color charts and color samples.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style A, floor supported. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be laminated plastic, with phenolic core, Finish 3. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 TOILET ACCESSORIES, shall be prepared for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

### 2.2 NOT USED

### 2.3 NOT USED

### 2.4 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. All hardware shall be provided for a complete installation including coat hooks, door latches, and pivots.

### 2.5 COLORS

Color of finishes for toilet partition system components shall be manufacturer's standard as indicated in the interior room finish key.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by through-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work.

### 3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

SECTION 10211

FIXED METAL WALL LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fixed louvers and frames.
- B. Insect screening.

1.2 RELATED SECTIONS

- A. Section 07600 - Sheet Metal Work, General.
- B. Section 07900 - Joint Sealers.
- C. Section 15895 - Air Supply Distribution, Ventilation, and Exhaust System.

1.3 REFERENCES

- A. AMCA 500 (Air Movement Control Association) - Test Method for Louvers, Dampers, and Shutters.
- B. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate.
- C. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- D. ASTM A527 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
- E. ASTM B209 - Aluminum-Alloy Sheet and Plate.
- F. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

1.4 PERFORMANCE REQUIREMENTS

- A. Louver: As indicated on the louver schedule.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

- A. SD-04 Shop Drawings

Metal Wall Louvers; GA.

Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

- B. SD-01 Product Data

Metal Wall Louvers; GA.

Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. SD-14 Samples

Metal Wall Louvers; GA.

Submit two samples 8 x 8 inch (203 x 203 mm) in size illustrating finish and color of exterior and interior surfaces.

D. SD-13 Manufacturer's Certificates

Metal Wall Louvers; FIO.

Certify that Products meet or exceed specified requirements

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA Certification for intake/exhaust louvers.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

- A. Coordinate the Work with installation of masonry flashings.

1.10 WARRANTY

- A. Provide twenty year warranty.  
B. Warranty: Include coverage for degradation of polyvinylidene fluoride.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B221, 6063-T5 alloy, temper; extruded shape; prefinished with shop applied fluoropolymer finish.

2.2 SCREENS

- A. Insect Screen: Aluminum mesh, set in aluminum frame.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Stainless steel type.  
B. Flashings: Of same material as louver frame. Sheet aluminum.

- C. Sealants: Exterior type specified in Section 07900.

#### 2.4 FABRICATION

- A. Louver Panel Thickness: As indicated on louver schedule.
- B. Louver Blade Design: Sloped at 45 degrees; reinforced with intermediate stiffeners, material thickness of .081 inch (2.06 mm) minimum, integral and lateral rain water stops positioned on blade.
- C. Louver Frame: Channel shape, welded corner joints, material thickness of .081 inch (2.06 mm) minimum.
- D. Intermediate Mullions: Recessed of extruded aluminum, profiled to suit louver frame.
- E. Head and Sill Flashings: Extruded to required shape, single length in one piece per location.
- F. Screens: Install screen mesh in shaped frame, reinforce corner construction, shop install to louver with fasteners.

#### 2.5 FINISHES

- A. Exterior and Interior Aluminum Surfaces, Screen. Prepainted finish of flouropolymer color as selected from manufacturers standard colors to match roof color.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Where applicable, verify that electric power is available and of the correct characteristics.

#### 3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louvers in opening framing with concealed fasteners.
- E. Install insect screen and frame to exterior of louver.
- F. Install insect screen and frame to intake louvers.
- G. Install perimeter sealant and backing rod in accordance with Section 07900.

3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION

SECTION 10440  
INTERIOR SIGNAGE

PART 1 GENERAL

1.1 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.1.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches.

1.1.2 Raised and Brailled Characters and Pictorial Symbol Signs  
(Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Interior Signage; GA.

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Drawings

Interior Signage; GA.

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-14 Samples

Interior Signage; GA.

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

- a. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

SD-19 Operation and Maintenance Manuals

Interior Signage; GA.

Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

### 1.3 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

### 1.5 EXTRA STOCK

The Contractor shall provide extra frames and extra stock of the following:  
2 blank plates of each color and size for sign types. 2  
pressure-sensitive letters in each color and size for sign type. 2  
changeable message strips for sign type.

## PART 2 PRODUCTS

### 2.1 ROOM IDENTIFICATION SIGNAGE SYSTEM

Signs shall be fabricated of Type ES/MP laminated thermosetting plastic suitable for engraving.

#### 2.1.1 Standard Room Signs

Signs shall consist of matte finish laminated thermosetting Type MP plastic. Units shall be frameless. Corners of signs shall be 1/2 inch radius.

#### 2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall consist of laminated thermosetting Type MP plastic Type MP plastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Size of signs shall be as shown on the drawings. Individual message strips to permit removal, change, and

reinsertion shall be provided. Corners of signs shall be 1/2 inch radius.

#### 2.1.3 Type of Mounting For Signs

Extruded aluminum brackets shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be provided with countersunk mounting holes in plaques and mounting screws. Sign inserts shall be provided with 1/16 inch thick foam tape.

#### 2.1.4 Graphics

Signage graphics for modular identification signs shall conform to the following:

Acrylic letters 1/8 inch thick and chemically welded to 0.125 inch thick acrylic backup sheet.

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

#### 2.8 FABRICATION AND MANUFACTURE

##### 2.8.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

##### 2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

#### 2.9 COLOR, FINISH, AND CONTRAST

Color shall be black. In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach

within 3 inches of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

## SECTION 10605

## WIRE MESH PARTITIONS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Wire mesh system for walls and ceiling.

## 1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete.
- B. Division 9 - Finishes.

## 1.3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A123 - Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- E. ASTM A446 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical Quality).
- F. ASTM A500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A501 - Hot-formed Welded and Seamless Carbon Steel Structural Tubing.
- H. ASTM A510 - General Requirements For Wire Rods and Course Round Wire, Carbon Steel.
- I. ASTM A580 - Stainless and Heat-Resisting Steel Wire.
- J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- K. ASTM B211 - Aluminum-Alloy Bars, Rods, and Wire.
- L. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- M. AWS D1.1 - Structural Welding Code.
- N. SSPC (Steel Structures Painting Council) - Painting Manual.

- 1.4 SUBMITTALS: Submit under provisions of Section 01300.

## A. SD-04 Shop Drawings

Wire Mesh Partitions; GA.

Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, framed openings, anchorage, welds, type and location of fasteners, and accessories or items required of related work.

## B. SD-01 Product Data

Wire Mesh Partitions; GA.

Mesh Partition Screen; GA.

Hardware; GA.

Provide data for screen materials, finishes, and hardware.

## C. SD-14 Samples

Wire Mesh Partition; GA.

Accessories; GA.

Submit two samples, 12" x 12" in size illustrating screen material. Submit samples of hinge latchset illustrating style, color, and finish.

Installation Instructions; FIO.

Indicate special procedures, perimeter conditions requiring special attention.

## D. SD-08 Statements

Qualifications; FIO.

## 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may

be incorporated in the work include, but are not limited to, the following:

Acorn Wire and Iron Works, Inc.  
The G-S Company  
Hoosier Fence Co., Inc.  
Indiana Wire Products, Inc.  
Kentucky Metal Products Co.  
King Wire Partitions Inc.  
Lakeside Wire and Iron Co.  
Miller wire Works, Inc.  
Wire and Iron Products, Inc.

## 2.2 HEAVY DUTY MESH PARTITIONS

- A. Mesh: 10-gage crimped steel wire woven into 1-1/2-inch diamond mesh, securely clinched to frame members.
- B. Frames: Provide cutouts for pipes, ducts, beams, and other items shown or necessary for partition installation. Finish edges of cutouts to provide a neat, protective edge.
- C. Frame Members: 1-1/4 inch by 5/8 inch cold rolled steel channels, conforming to ASTM A36, with 3/8 inch bolt holes approximately 18 inches o.c.
  - 1. Horizontal Reinforcing Members: 1-1/2 inch by 3/4 inch by 1/8 inch cold rolled steel channel with wire woven through, or two 1-inch by 1/2 inch channels bolted or riveted toe-to-toe through the mesh and secured to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.
- D. Stiffening Bars: Provide flat bar stiffener posts between all abutting panel frames. Size as recommended by partition manufacturer for partition height required. Increase size of stiffening bars if required to maintain partition rigidity.
- E. Top Capping Bars: 3 inch by 4.1 pound channel secured to top framing members with 1/4 inch "U" bolts spaced not more than 28 inches o.c.
- F. Line Posts: Where partition runs exceed 20 feet without intersection or connection to overhead framing, furnish 3 inch by 4.1 pound channel line posts with 5 inch by 18 inch by 1/4 inch base plates located at recommended intervals to ensure partition rigidity and stability.
- G. Floor Shoes: Cast metal, sized to suit vertical framing and to provide approximately 3 inches clear space between finished floor and bottom horizontal frame members. Furnish units with set screw for leveling adjustment.

### 2.3 DOORS

- A. Hinged Door: Door frame of 1-1/2" x 3/4" channel with 1-1/2 x 1/8" flat bar cover three sides. 1-5/8" x 7/8" x 1/8" angle riveted to lock side. Refer to 08700 Builder's Hardware for Cage Door Hardware.
- B. Cylinders for locks are specified in Section 08700.

### 2.4 WINDOW GUARDS

- A. Horizontal Reinforcing Members: Two 1 inch by 3/8 inch channels riveted toe-to-toe through the mesh and welded to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.
- B. Anchorage Devices: Furnish appropriate types and quantities of anchorage devices to provide adequate anchorage to adjacent structures.

### 2.5 FABRICATION

- A. Do not use components less than sizes indicated. Use larger size components as recommended by partition component manufacturer.
- B. Provide bolts, hardware, and accessories for complete installation.
- C. Finish: Manufacturer's standard shop-applied enamel finish. Provide manufacturer's standard finish color.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

### 3.2 INSTALLATION

- A. Erect partitions plumb, rigid, properly aligned, and securely fastened in place, complying with drawings and manufacturer's recommendations.
- B. Provide additional field bracing as shown or necessary for rigid, secure installation. Erector to provide additional clips and bracing as required.

- C. Installation: All bolts shall be welded or peened to eliminate removal of nuts.

3.3 ADJUST AND CLEAN

- A. Adjust moving components for smooth operation without binding.
- B. Touch-up damaged finish after completion of installation using field-applied paint to match color of shop-applied finish.

END OF SECTION

SECTION 10800  
TOILET ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991) Flat Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation, submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Finishes; GA. Accessory Items; GA.

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-14 Samples

Finishes; GA. Accessory Items; GA.

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

SD-19 Operation and Maintenance Manuals

Six complete copies of maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs. Instructions shall include simplified wiring and control diagrams and other information necessary for unit maintenance.

1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Toilet accessories shall be provided as indicated on the drawings. Each accessory item shall be complete with the necessary mounting plates and shall be of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

2.2.1 NOT USED

2.2.2 Grab Bar (GB)

Grab bar shall be 18 gauge, 1-1/4 inches OD Type 304 stainless steel. Grab bar shall be form and length as indicated. Concealed mounting flange shall have mounting holes concealed. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 1-1/2 inch.

2.2.3 NOT USED

2.2.4 Mirrors, Glass (MG)

Glass for mirrors shall be Type I transparent flat type, Class 1-clear. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.5 NOT USED

2.2.6 NOT USED

2.2.7 NOT USED

## 2.2.8 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 18 gallons. Unit shall be fabricated of not less than 0.30 inch stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

## 2.2.9 Combination Recessed Toilet Seat Cover Dispenser, Sanitary Napkin Disposal, Toilet Tissue Dispenser

Recessed toilet-seat-cover dispenser, sanitary napkin disposal, and toilet tissue dispenser shall be type 304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Flange shall be drawn and beveled, one-piece, seamless construction. Unit shall mount flush against side wall of barrier-free toilet compartment to allow clearance for grab bar across front of unit. Door shall be one-piece, seamless construction, secured to cabinet with a full-length stainless steel piano-hinge, and equipped with a tumbler lock keyed like other Bobrick washroom accessories. Toilet-seat-cover dispenser shall fill from below the internal shelf and hold 500 paper covers. Self-closing disposal panel shall be secured to door with a spring-loaded, full-length stainless steel piano-hinge and equipped with an international graphic symbol identifying napkin disposal. Sanitary napkin disposal shall be furnished with a removable, leak-proof, molded polyethylene receptacle and shall have a capacity of 0.8 gal. (3.0L). Unit shall be equipped with two theft-resistant, high-impact polystyrene toilet tissue spindles that hold standard-core rolls up to 5-1/4" (135 mm) diameter (1800 sheets). Spindles shall be removable from cabinet when door is open; when door is closed, removal shall require a special key provided for the concealed locking mechanism in spindles.

2.2.10 NOT USED

2.2.11 NOT USED

2.2.12 NOT USED

## 2.2.13 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps. Lavatory mounted, liquid type consisting of a polyethylene tank with a minimum 32 fluid ounces holding capacity and a 6 inch spout length.

2.2.14 NOT USED

## 2.2.15 Shelf, Metal, Heavy Duty (SMHD)

Heavy duty metal shelf shall be minimum of 18 gauge stainless steel with hemmed edges. Shelves over 30 inches shall be provided with intermediate supports. Supports shall be minimum of 16 gauge, shall be welded to the shelf, and shall be spaced no more than 30 inches apart.

2.2.16 NOT USED

2.2.17 NOT USED

2.2.18 NOT USED

2.2.19 NOT USED

2.2.20 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted recess mounted with two rolls of standard tissue mounted horizontally. Cabinet shall be stainless steel, satin finish.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet accessories shall be securely fastened to the supporting construction in accordance with the manufacturer's approved instructions. Accessories shall be protected from damage from the time of installation until acceptance.

3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

-- End of Section --

## SECTION 11213

## PERMANENT PUMP

## PART 1 GENERAL

## 1.1 SCOPE OF WORK

This section includes all equipment, labor, materials, and appurtenances necessary to install and place into operation a submersible pump for the groundwater extractions well. The installation shall include one (1) submersible pump for the water supply well. The pump shall be driven by a motor attached below the pump section. The pump shall be furnished by one supplier, who shall be responsible for furnishing, testing, start-up, and successful operation of all of the equipment specified under this section. All work in connection with the manufacture, delivery, and installation of the equipment shall be complete so that equipment is ready for service, referred to in Section 02523 SUBMERSIBLE PUMP INSTALLATION.

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

## 1.2.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model, serial number, and catalog number on a plate secured to the item of equipment. Submersible pumps and motors shall also have identical nameplates affixed in a conspicuous place to the pumphouse wall or discharge piping. In addition, the nameplate for each pump shall show the capacity in gallons per minute at rated head in feet and speed in the revolutions per minute. Nameplate for each electric motor shall show the horsepower, speed in revolutions per minute, full load current, voltage, frequency, phases, time rating, maximum ambient temperature, insulation class code letter, and service factor.

## 1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of this work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Submersible Pump; GA.

Manufacturer's descriptive data and technical literature, performance

charts and curves, catalog cuts, and installation instructions.

Spare parts for each different item of material and equipment specified, after approval for the detail drawings no later than 1 month prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 year(s) of service.

#### SD-04 Drawings

Submersible Pump; GA.

Detail drawings consisting of equipment and materials. Detail drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

#### SD-06 Instructions

Submersible Pump; FIO.

Proposed diagrams, instructions, and other sheets prior to posting

#### SD-09 Reports

Testing; FIO.

Tests reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of the controls.

#### SD-19 Operation and Maintenance Manuals

Submersible Pump; FIO.

Six complete copies of operating manual outlining the step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include simplified wiring, layout, and control diagrams of the system as installed.

## PART 2 PRODUCTS

### 2.1 PUMP REQUIREMENTS

#### 2.1.1 Type of Installation

The work shall include furnishing, installing, and testing submersible pumps and their appurtenances as indicated. Pumps shall be utilized for potable water and fire suppression water supply and installed in the well.

#### 2.1.2 Well Data

Pumps shall be suitable for installation in the well casings and under the conditions indicated.

## 2.2 PUMP PERFORMANCE

Pumps shall be capable of discharging quantities of water at a maximum speed and total pump head with the minimum efficiency indicated. Total pump head in feet shall consist of the pumping level below the datum and the static and friction head above the datum at design capacity.

## 2.3 SUBMERSIBLE PUMP

Based on the anticipated required pump capacities and head losses, the pump units shall be a 10-hp Grundfos 85S100-8 pump model with Teflon seals or approved equal. The pump shall be designed for connection to piping as indicated. A strainer shall be provided at the pump suction. Pumps shall be operable at heads ranging from 25 percent above or below the normal design head. The pump and motor shall be at least 1 inch smaller than the inside diameter of well screen or casing, whichever is less.

### 2.3.1 Pump Head Assembly

Pump head assembly shall consist of the surface plate from which the vertical discharge pipe is suspended and an elbow or fitting (pitless adapter) as required for connecting to the piping system. Head assembly shall be provided with eyebolts, lugs, or other means of securing sling to facilitate setting and lifting.

### 2.3.2 Pump Bowl Assembly

The pump bowls, impellers, guide vanes, and filter screen shall be 300 Series stainless steel. Each impeller shall have a Teflon seal ring around its eye or skirt to reduce hydraulic losses. There shall be a Teflon shaft bearing located either above or below each impeller. A 300 Series stainless steel filter screen shall be included as part of the suction inlet assembly.

### 2.3.3 Discharge Pipe

Discharge pipe shall be sized as shown. Discharge column retainers or spiders shall be utilized to maintain the discharge pipe centered in the well casing. A minimum of one retainer shall be provided for each 50 feet of discharge pipe. Provisions shall be made for fastening the retainer spiders to prevent them from sliding on the pipe and damaging the power cable when the pump is installed in the well.

### 2.3.4 Check Valves

A Check valve shall be provided in the column pipe at a pipe joint as recommended by the pump manufacturer. The check valve shall be vertical type, made of 300 Series stainless steel, of the same size as the pipe column in which it is installed. The check valve seat shall be Teflon with a 300 Series stainless steel insert. The check valve shall be designed to hold the column full of water.

## 2.4 PUMP ACCESSORIES

### 2.4.1 Water-Level Indicator Assembly

A water-level indicator assembly shall be provided for the pump installation. Indicator shall be air line-type.

#### 2.4.1.1 Air-line Indicator

Air-line type shall be manual and shall include a galvanized pipe or copper tube inserted between the well casing and the pump discharge column and shall extend a minimum of ten feet below the lowest pumping water level. Manual water-level indicator assembly shall include a pressure gauge, check

or bicycle valve, and air pump. The pressure gauge shall read in feet and shall have a range capable of permitting water-level measurement in the well under any conditions. A plastic or corrosion-resistant metal plate shall be affixed to the air line pressure gauge or pump house wall indicating the exact distance from the centerline of the pressure gauge to the end of the air line.

#### 2.4.2 Pressure Gauge

A pressure gauge of the direct-reading type, equipped with a shut-off cock and snubber, shall be provided on the discharge from the pump. Pressure gauge shall conform to ASME B40.1 and shall be calibrated in pounds per square inch in not more than 2 psi increment from zero to a minimum of 5 psi above the shut-off head of the pump. Rating point shall be at approximately the mid-point of the scale.

#### 2.4.3 Air-Vent Valve

Air-vent valve with the necessary pipe connections shall be provided to permit the automatic escape of air from the discharge column when the pump is started. Size of the air-vent valve and piping shall suit the actual requirements of the installation and the recommendations of the pump manufacturer.

### 2.5 ELECTRICAL EQUIPMENT

#### 2.5.1 General

Electrical motor-driven equipment specified shall be provided complete with motors, motor starters, and controls. Motor controls, equipment and wiring shall be specified in Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.5.2 Submersible Pumps

##### 2.5.2.1 Motor Design and Materials of Construction

The submersible pump motor shall be designed and manufactured expressly for the intended use. The motor shall be rated 208 volts, 3 phase, 60 Hz and such rating shall be stamped on the nameplate. The motor shall be a Franklin 4-inch squirrel-caged canned motor designed for submersible operation in conformance with NEMA standards, or equivalent. All materials in contact with the pumped fluids shall be 300 Series stainless steel or Teflon. The motor shall be water lubricated.

#### 2.5.3 Power Cables

Submersible pump power cables shall be specifically designed for use with submersible pumps, and shall be as recommended by the manufacturer of the motor with which the cables are used. Each cable shall not be less than No. 12AWG stranded copper and shall have the ampacity of not less than 125 percent of the motor full load current. Each conductor shall be insulated with a heat resistant, moisture resistant synthetic rubber or thermosetting plastic jacket. A separate stranded, green insulated, grounding conductor shall be provided for each circuit. Submersible cables shall be suitable for continuous immersion in water at the maximum depth encountered. Cables shall be securely supported from the pump column at intervals not to exceed 15 feet by corrosion resistant bands or clamps designed to prevent damage to the cable jacket. Except where cables connected to the motor terminal wiring, cables shall contain no splices in the length from the junction box or motor starter to the motor. Cables shall be terminated at the junction box or motor starter with a watertight cable connector. Splices in cables will be allowed only at the connection to the motor. Splices shall be factory fabricated and tested and shall be waterproof and suitable for continuous immersion at the maximum depth encountered. For each 50 feet of setting depth, 1 foot of extra cable length shall be provided to compensate

for possible twist or snag of the cables during installation. Where cables pass the pump bowl assembly, cables shall be flat or protected against damage by corrosion-resistant shield forming a smooth rounded surface. Sharp bends in the cables at the shield or at the connection to the motor will not be allowed.

## 2.6 EQUIPMENT APPURTENANCES

### 2.6.1 Attachments

All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A 123 or ASTM A 153 as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel shall be Type 316.

### 2.6.2 Special Tools

A complete set of all special tools, which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered those tools, which because of their limited use are not normally available, but which are necessary for the particular equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Contracting Officer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

The submersible pump shall be installed in accordance with SECTION 02523 (Submersible Pump Installation), following installation of the concrete vault. The arrangement of the pump unit and the suction and discharge piping is shown on the drawings. The arrangements shown are based upon the pumps of a particular manufacturer; however, any manufacturer's pumps that meet the requirements of these Specifications will be accepted. Additional costs due to revisions in piping or structures, required by any particular manufacturer's equipment, shall be borne by the Contractor.

### 3.2 PAINTING AND FINISHING

Unless otherwise specified all exposed ferrous metal not factory finished shall be painted as specified in Section 09900 PAINTING, GENERAL. No factory finished equipment or appurtenances shall be painted except that damaged factory finishes shall be retouched in an acceptable manner with paint obtained from the manufacturer. Nameplates shall not be covered with paint but shall be cleaned and legible at completion of work.

### 3.3 TESTING

Factory pump performance test shall be made in conformance with AWWA E101 for the following:

- a. Running test.
- b. Witnessed running test.
- c. Sample calculation from test readings.
- d. Shop inspection.
- e. Hydrostatic test of bowl assembly.

### 3.3.1 Field Equipment Test

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. The pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours. The pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer.

The Contractor shall provide an accurate and acceptable method of measuring the discharge flow. For submersible pumping units, an insulation resistance test of the cable and motor shall be conducted prior to installation of the pump, during the installation of the pump, and after the installation is complete. The resistance readings shall be not less than 10 megohms.

#### 3.3.1.1 Correct Installation of Appurtenances

Test shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manuals and automatic controls function properly.

#### 3.3.1.2 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected, within one (1) week and the tests shall be re-conducted. If the deficiency cannot be corrected within one (1) week, the pump shall be replaced, at no cost to the Contracting Officer.

### 3.4 FIELD TRAINING

Contractor shall conduct a training course for the maintenance and operating staff. The training period of 4 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. Contracting Officer shall be given at least two weeks advanced notice of such training.

### 3.5 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above the wiring and control diagrams. The framed instructions shall be posted before acceptance testing of the systems.

-- End of Section --

## SECTION 12320

## CABINETS AND COUNTERTOPS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA ANSI/BHMA A156.9 (1994) Cabinet Hardware

## KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA ANSI/KCMA A161.1 (1995) Recommended Performance & Construction Standards for Kitchen and Vanity Cabinets

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High-Pressure Decorative Laminates

## 1.2 DESIGN

Cabinets shall be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Cabinets shall be constructed as specified and shall meet the requirements of KCMA ANSI/KCMA A161.1. Wall and base cabinet assemblies shall consist of individual units joined into continuous sections. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation. Counters shall be provided with watertight sink rim when indicated. Drawers shall be removable and shall be equipped with position stops to avoid accidental complete withdrawals. Shelves shall be fixed or adjustable as indicated.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Cabinets and Countertops; GA.

Manufacturer's printed data, catalog cuts, installation and cleaning instructions.

## SD-04 Drawings

Cabinets and Countertops; GA.

Drawings showing each type of cabinet and related item, and clearly indicating the complete plan, location, and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and

attachments.

#### SD-09 Reports

Cabinets and Countertops; FIO.

Test reports certifying that all cabinets comply with the requirements of KCMA ANSI/KCMA A161.1. Tests shall be conducted by independent laboratories approved by KCMA. KCMA certification seals affixed to the cabinets will be accepted in lieu of certified test reports.

#### SD-14 Samples

Cabinets and Countertops; GA.

Samples shall be of sufficient size to show color, pattern, and method of assembly.

- a. Counter top and backsplash - One section, containing both.
- b. Door and drawer front - One of each, with hardware mounted.
- c. Melamine plastic color samples approximately 2 x 3 inches size.
- d. Paint/color samples approximately 2 x 3 inches size.

### 1.4 DELIVERY AND STORAGE

Cabinets shall be delivered to the jobsite wrapped in a protective covering. Cabinets shall be stored in accordance with manufacturer's recommendations in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Cabinets shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

## PART 2 PRODUCTS

### 2.1 CABINETS

Wall and base cabinets shall be of the same construction and same outside appearance. Door design shall be framed inset hardwood panels from vendors standard styles. Shelves shall be fixed or fully adjustable as indicated. Adjustable shelves shall be capable of adjusting on approximately 3 inch increments. Shelves shall be supported by self-locking clips or wood dowels. Dowels shall be approximately 5/16 inch in diameter by 1-9/16 inches long. Dowels shall be inserted into borings for the shelf adjustments. Shelves shall be minimum 1/2 inch thick plywood. Drawer fronts shall be 3/4 inch thick solid hardwood frame 7/16 inch solid wood panel.

#### 2.1.1 Frame Type Cabinets

The cabinets shall be constructed with frame fronts and solid ends, or frame construction throughout. Frame members shall be 3/4 inch thick by 1-1/2 inch wide; kiln-dried hardwood, glued together, and shall be either mortised and tenoned, dovetailed or doweled, nailed or screwed. Top and bottom corners shall be braced with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of wall cabinets shall be 1/8 inch thick plywood, or tempered hardboard. Backs of base and tall cabinets shall be 3/8 inch thick hardwood. Bottoms of cabinets shall be minimum 3/8 inch thick plywood or sound grade plywood and shall be braced with wood members glued in place. Cabinet ends shall be 5/8 inch thick hardwood plywood.

## 2.2 COUNTERTOPS AND BACKSPLASH

Countertop and backsplash shall be constructed of 3/4 inch thick plywood and shall be post formed cove type. Cove type shall be a single unit with self-edging and plastic laminate coved at the juncture of the countertop and backsplash. Backsplash shall be not less than 3-1/2 inches high. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 3/4 inch plywood shall be supplied.

## 2.3 Sink Rims

Sink rims shall be of the corrosion resistant steel clamping type, sized to the sink, and a standard product of a manufacturer regularly producing this type of equipment.

## 2.4 FINISH

### 2.4.1 Cabinet Finish

Cabinets shall be provided with a factory-applied durable finish in accordance with KCMA ANSI/KCMA A161.1 requirements and of a type standard with the manufacturer. Painted wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides shall be fabricated of wood which will be free of extreme color variations within each panel or between adjacent panels. Exposed exterior surfaces shall be paint-finished wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides fabricated of hardwood or grade C hardwood veneer.

### 2.4.2 NOT USED

### 2.4.3 Melamine Laminates on Countertops

Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are one unit, PF42 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3 and plastic laminate adhesive shall be contact type applied to both surfaces. For cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer.

### 2.4.4 Backer Sheets

Backer Sheets of high pressure plastic laminate, shall conform to NEMA LD 3, Grade BK20 and shall be applied to the underside of all core material.

## 2.5 HARDWARE

Hardware shall conform to BHMA ANSI/BHMA A156.9, shall be suitable for kitchen cabinet use, and shall include all miscellaneous hardware for a complete installation. Door hinges shall be self-closing type. Drawer runners shall have nylon rollers standard with the manufacturer. Hardware and fastenings for doors and drawers with plywood cores shall be of the through-bolt type.

## 2.6 COLOR, TEXTURE, AND PATTERN

Design, color, and finish shall be as indicated in the interior room finish key.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Cabinets shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with suitable devices to securely anchor each unit. Countertops, accessories, and hardware shall be installed as indicated. Installation shall be in accordance with the manufacturer's approved printed instructions. The inner edge of sink cut-outs in laminated plastic tops shall be painted with a coat of semigloss enamel paint and sink flanges shall be set in a bed of sealant. Closer and filler strips and finish moldings shall be provided as required. Prior to final acceptance, doors shall be aligned, and hardware shall be adjusted.

### 3.2 CLEANING

Cabinet and countertop surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

SECTION 13100  
LIGHTNING PROTECTION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

NFPA 780 (1997) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96 (1994; Rev thru Dec 1996) Lightning Protection Components

UL 96A (1994) Installation Requirements for Lightning Protection Systems

UL 467 (1993; Rev thru Aug 1996) Grounding and Bonding Equipment

UL Elec Const Dir (1997) Electrical Construction Materials Directory

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

## 1.2.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

## 1.3 SUBMITTALS

SD-04 Drawings

Lightning Protection System.

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

#### SD-13 Certificates

Materials and Equipment; GA.

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL Elec Const Dir will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. A letter of findings shall be submitted certifying UL inspection of lightning protection system

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

##### 2.1.2.1 Copper

Copper conductors used on nonmetallic stacks shall weigh not less than 375 pounds per thousand feet, and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 2/0 AWG.

#### 2.1.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. The tip of air terminals on buildings used for manufacturing, processing, handling, or storing explosives, ammunition, or explosive ingredients shall be a minimum of 2 feet above the ridge parapet, ventilator or perimeter. On open or hooded vents emitting explosive dusts or vapors under natural or forced draft, air terminals shall be a minimum of 5 feet above the opening. On open stacks emitting explosive dusts, gases, or vapor under forced draft, air terminals shall extend a minimum of 15 feet above vent opening. Air terminals more than 24 inches in length shall be supported by a suitable brace, with guides not less than one-half the height of the terminal.

#### 2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to ANSI C135.30. Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the job.

#### 2.1.5 Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation. Clamp-type connectors shall only be used for the connection of the roof conductor to the air terminal and to the guttering. All other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be listed for the purpose. The high compression fittings shall be the type which require a hydraulically operated mechanism to apply a minimum of 10,000 psi.

#### 2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

### PART 3 EXECUTION

#### 3.1 INTEGRAL SYSTEM

##### 3.1.1 General Requirements

The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

##### 3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 2 feet from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 2 feet in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 25 feet.

In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 2 inches for each foot of increase over 25 feet. On large, flat or gently sloping roofs, as defined in NFPA 780, air terminals shall be placed at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, smokestacks, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, air terminals shall be mounted

thereon, where practicable. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom. Where metal ventilators are installed with air terminals mounted thereon, the air terminal shall not be more than 24 inches away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement. Where metal ventilators are installed with air terminals mounted adjacent, the air terminal shall not be more than 24 inches away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement.

#### 3.1.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 8 inches. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

#### 3.1.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, there shall be at least one additional down conductor for each additional 50 feet of length or fraction thereof. On rectangular structures having French, flat, or sawtooth roofs exceeding 250 feet in perimeter, there shall be at least one additional down conductor for each 100 feet of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each wing.

On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 100 feet. On structures exceeding 50 feet in height, there shall be at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application shall not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 16 feet in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected by placing in pvc conduit for a minimum distance of 6' above finished grade level.

#### 3.1.1.4 NOT USED

#### 3.1.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down

conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

#### 3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, nor more than 8 feet, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 10 ohms if a counterpoise is not used. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 24 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 10 ohms, the Contracting Officer shall be notified immediately. A counterpoise, where required, shall be of No. 2/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors or their equivalent in the form of metal strips or wires are then buried in the trenches.

#### 3.1.2 Metal Roofs

Wood-Frame, Wall-Bearing Masonry or Tile Structure with Metallic Roof and Nonmetallic Exterior Walls, or Reinforced Concrete Building with Metallic Roof: Metal roofs which are in the form of sections insulated from each other shall be made electrically continuous by bonding. Air terminals shall be connected to, and made electrically continuous with, the metal roof as well as the roof conductors and down conductors. Ridge cables and roof conductors shall be bonded to the roof at the upper and lower edges of the roof and at intervals not to exceed 100 feet. The down conductors shall be bonded to roof conductors and to the lower edge of the metal roof.

Where the metal of the roof is in small sections, the air terminals and down conductors shall have connections made to at least four of the sections. All connections shall have electrical continuity and have a surface contact of at least 3 square inches.

#### 3.1.3 Metal Roofs With Metal Walls

Wood-Frame Building With Metal Roof and Metal Exterior Walls: The metal roof and the metal walls shall be bonded and made electrically continuous and considered as one unit. The air terminals shall be connected to and made electrically continuous with the metal roof as well as the roof and down conductors. All connections shall have electrical continuity and have a surface contact of at least 3 square inches.

#### 3.1.4 Steel Frame Building

The steel framework shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding steel frame, unless a specific method is noted on the drawings. The air terminals shall be connected to the structural steel framework at the ridge. Short runs of

conductors shall be used as necessary to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where a grounded metal pipe water system enters the building, the structural steel framework and the water system shall be connected at the point of entrance by a ground connector. Connections to pipes shall be by means of ground clamps with lugs. Connections to structural framework shall be by means of nut and bolt or welding. All connections between columns and ground connections shall be made at the bottom of the steel columns. Ground connections to grounding electrodes or counterpoise shall be run from not less than one-half of all the columns distributed equally around the perimeter of the structure at intervals averaging not more than 60 feet.

### 3.1.5 NOT USED

### 3.1.6 Igloo-Type Magazines

In earth-covered reinforced-concrete, igloo-type magazines, the reinforcing steel shall be made electrically continuous. Electrical continuity may be provided by clipping or brazing, unless a specific method is noted on the drawings. The air terminals and roof conductors shall be securely connected to, and made electrically continuous with, the reinforcing steel.

One air terminal shall be located on the top of the front wall and one on or adjacent to the ventilator in the rear. The air terminals shall extend vertically at least 2 feet above the top of the front wall and the highest point on the ventilator. Down conductors and grounding electrodes shall be provided at diagonally opposite corners of the magazine and shall be connected together. Grounding electrodes shall be connected to the horizontal reinforcing rods below the floor line of the wall system. The steel door frame shall be made electrically continuous with the reinforcing steel. The steel door shall be connected to the steel frame by means of a flexible copper strap or cable unless the steel hinges make the door and frame electrically continuous.

### 3.1.7 Tanks and Towers

#### 3.1.7.1 NOT USED

#### 3.1.7.2 Metal or Reinforced-Concrete Tanks and Towers

The metal or reinforcing steel shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding metal and tying or clipping reinforcing bars, unless a specific method is noted on the drawings. Air terminals and down conductors are required except on bolted, riveted, or welded 3/16-inch minimum, steel plate tanks. Ground connections and grounding electrodes are not required on metal tanks that are electrically continuous with a metallic underground pipe system. On other structures, two ground connections shall be provided approximately 180 degrees apart, at the base of the structure. Where buried metal pipes enter the tank or tower, one ground connection shall be connected to them, approximately 1 foot below finished grade. Metal guy wires on tanks and towers shall be grounded. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as grounded. Metal guy wires or cables set in concrete or attached to buildings or nonconducting supports shall be grounded to a ground rod driven full length into the ground.

### 3.2 NOT USED

### 3.3 NOT USED

### 3.4 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of

protection of an air terminal. Metal bodies of conductance having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected thereto shall be independently grounded.

### 3.5 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 1000 to 1500 feet of length when fences are located in isolated places, and every 500 to 750 feet when in proximity ( 100 feet or less) to public roads, highways, and buildings. Where the fence consists of wooden posts and horizontal metal strands only, down conductors consisting of No. 8 copper wire or equivalent shall be run from the ground rod the full height of the fence and fastened to each wire, so as to be electrically continuous. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 150 feet on each side of line crossings.

### 3.6 NOT USED

### 3.7 NOT USED

### 3.8 NOT USED

### 3.9 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

SECTION 13120  
STANDARD METAL BUILDING SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC-04	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design
AISC Pub No. S342 L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01	(1996) Cold-Formed Steel Design Manual
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 252	(1996) Welded and Seamless Steel Pipe Piles
ASTM A 463/A 463M	(1996a) Steel Sheet, Aluminum-Coated by the Hot-Dip Process
ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1996) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M	(1997a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1997) Steel, Sheet and Strip,

High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance

ASTM A 607 (1996) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled

ASTM A 618 (1996) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing

ASTM A 653/A 653M (1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 792/A 792M (1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B 241/B 241M (1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

ASTM B 308/B 308M (1996) Aluminum-Alloy 6061-T6 Standard Structural Profiles

ASTM B 429 (1995) Aluminum-Alloy Extruded Structural Pipe and Tube

ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 991 (1992) Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings

ASTM D 522 (1993a) Mandrel Bend Test of Attached Organic Coatings

ASTM D 523 (1989; R 1994) Specular Gloss

ASTM D 714 (1987; R 1994) Evaluating Degree of Blistering of Paints

ASTM D 968 (1993) Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D 1308 (1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes

ASTM D 1654 (1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 2244 (1993) Calculation of Color Differences from Instrumentally Measured Color

## Coordinates

ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995a) Measuring Adhesion by Tape Test
ASTM D 4214	(1997) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	s(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light - and Water-Exposure Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)	
ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)	
MBMA-01	(1996) Low Rise Building Systems Manual
SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)	
SMACNA-02	(1993; Errata) Architectural Sheet Metal Manual

## 1.2 GENERAL REQUIREMENTS

The metal building system covered under this specification shall be provided by a single manufacturer and shall include all components and assemblies that form a building. Structural standing seam metal roofing in this specification applies to the inspection and residue/turn-in buildings only. Structural Standing Seam Metal Roofing System, when specified, shall be furnished as part of a single manufacturer's system.

## 1.2.1 Building Configuration

Buildings shall have structural steel main building frames, and secondary framing including purlins and girts, engineered and fabricated by the building systems supplier. Buildings shall have vertical steel walls and gable roof system including soffits, gutters and downspouts. Roof slope shall be as shown on the drawings. Buildings shall be single-span structures with one of the following framing systems: continuous beam frames, column with rigid frame or rigid frame. Exterior doors and louvers shall be included in the metal building system. Building dimensions shall be not less than those indicated. The minimum inside clear dimensions shall be as shown on the drawings.

## 1.2.2 Qualifications

### 1.2.2.1 Manufacturer

Metal building shall be the product of a recognized steel building systems manufacturer who has been in the practice of manufacturing steel building systems for a period of not less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating steel building systems. The manufacturer shall be certified under the Metal Building Systems (MB) Certification Program, AISC FCD. Structural framing and covering shall be designed by a licensed Professional Engineer experienced in design of this work.

### 1.2.2.2 Installer

Erector shall have specialized experience in the erection of steel building systems for a period of at least 3 years. Framing shall be erected in accordance with MBMA-01, common industry practices and erection instructions describing the basic sequence of assembly, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads acting on the exposed framing, such as wind loads and seismic forces, as well as loads due to erection equipment and erection operation. Bracing furnished by the manufacturer for the metal building system shall not be assumed to be adequate during erection. Structural members shall not be field cut or altered without approval of the metal building manufacturer. Welds, abrasions, and surfaces not shop primed shall be primed after erection.

### 1.2.2.3 Manufacturer's Representative

A representative designated by the building manufacturer, who is familiar with the design of the building supplied and experienced in the erection of metal buildings similar in size to the one required under this contract, shall be present at the job site during construction, from the start of the structural framing erection until completion of the installation of the exterior covering, to assure that the building is erected properly.

## 1.3 DESIGN REQUIREMENTS

Criteria, loading combinations, and definitions shall be in accordance with MBMA-01.

### 1.3.1 Dead Loads

The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.

### 1.3.2 Collateral Loads

Collateral load of 5 pounds per square foot shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be shown on the shop (detail) drawings and the structure (frame, purlins, girts) shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds before design of the building commences.

### 1.3.3 Roof Live Loads

#### 1.3.3.1 Uniform Loads

Uniform roof live loads, including maintenance traffic and construction loads, shall be determined and applied in accordance with MBMA-01.

#### 1.3.3.2 Concentrated Loads

In addition to MBMA-01 roof live loads, a minimum design concentrated load of 300 pounds shall be used to simulate a construction load on roof panels. The concentrated load shall be applied at the panel midspan and shall be resisted by a single standing seam metal roof panel, or a 24 inches wide corrugated metal panel, assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

#### 1.3.4 Roof Snow Loads

The design roof snow loads, including effects of drifting, shall be determined and applied in accordance with MBMA-01 unless otherwise shown on the contract drawings.

#### 1.3.5 Wind Loads

Wind pressures shall be computed and applied in accordance with MBMA-01 unless otherwise shown on the contract drawings.

#### 1.3.6 Seismic Loads

Seismic loads shall be computed for seismic zone 1 in accordance with ASCE 7 using an importance factor of 1.

#### 1.3.7 NOT USED

#### 1.3.8 Foundations

Foundations shall be designed for an allowable soil bearing pressure of 4000 psf, a minimum bottom of footing depth of 3.5 feet below finish floor elevation, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

#### 1.3.9 Framing and Structural Members

Structural steel members and their connections shall be designed in accordance with AISC-04 or AISC Pub No. S342 L. Structural cold-formed steel framing members and their connections shall be designed in accordance with AISI-01. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180th of the span length. Members with openings in their webs shall be designed with consideration of the additional stresses which will result due to the openings. Deflections of the steel framing above and along the side of commercially framed door openings shall be limited to a maximum allowable deflection of 1/360 of the opening width to ensure proper operation of the doors. The contractor shall include the loads that the door transfers to the building frame in the design. Framed openings shall be designed to structurally replace the covering and framing displaced.

#### 1.3.10 Roofing and Siding

Except as otherwise specified, steel roofing and siding shall be designed in accordance with AISI-01. Maximum deflection for wall and roof panels under applied live load, snow or wind loads shall not exceed 1/180th of the span length. The design analysis shall establish that the roof, when deflected under loading combinations, shall not result in ponding. Maximum deflections shall be based on sheets continuous across two or more supports

with sheets unfastened and fully free to deflect. The calculated deflection from the concentrated load shall not exceed 1/180 of the span length. The methods for resisting lateral loads shall be cross-bracing, rigid frames, or wind columns.

#### 1.3.11 Provisions for Gutters And Downspouts

Gutters and downspouts shall be designed according to the requirements of SMACNA-02 for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads.

#### 1.3.12 Provisions for Louvers

Louvers shall be fixed-blade type designed for a minimum net open area as indicated, to be rainproof, and to resist vibration.

#### 1.3.13 Ventilators

#### 1.3.14 Drift Provisions

Lateral deflections, or drift, at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force resisting elements, shall conform to MBMA-01, but in no case should exceed height/180..

#### 1.3.15 NOT USED

#### 1.3.16 Grounding and Lightning Protection

Grounding and lightning protection shall be provided as specified in Section 13100 LIGHTNING PROTECTION SYSTEM.

### 1.4 DESIGN ANALYSIS

The design analysis shall be the design of a licensed Professional Engineer experienced in design of this work and shall include complete calculations for the building, its components, and the foundations. Foundations shown on the drawings are based on loads derived from a representative set of similar building types. The Contractor shall obtain the services of a licensed Professional Engineer to verify that the foundations shown are adequate for the building supplied using the criteria in paragraph Foundations. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. Wind forces on various parts of the structure, both positive and negative pressure, shall be calculated with the controlling pressure summarized. Lateral forces due to seismic loading shall be calculated and tabulated for the various parts and portions of the building. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included. Computer program output shall be annotated and supplemented with sketches to verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer, who shall function as a point of contact to answer questions during the detail drawing review.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Design Analysis; GA.

Design analysis (building and foundations including anchor bolt plans) as one package with the drawings.

Instruction Manuals; GA.

Manufacturer's literature for individual building component systems.

Erection Procedures; GA.

Manufacturer's erection instruction and erection drawings describing the preparation requirements, assembly sequence, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components.

## SD-04 Drawings

Metal Building Systems; GA.

Detail drawings consisting of catalog cuts, design and erection drawings, and an isometric view of the roof showing the design wind uplift pressure and dimensions of edge and corner zones. Shop painting and finishing specifications. Anchor bolt placement plan and column reactions.

## SD-08 Statements

Qualifications; FIO.

Qualifications of the manufacturer, the manufacturer's Representative when one is used, and qualifications and experience of the building erector. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall also include information regarding date of completion, name and address of owner, and how the structure is used.

## SD-13 Certificates

Metal Building Systems; GA.

a. A Certificate from the metal building manufacturer stating that the metal building was designed from a complete set of the contract drawings and specifications and that the building furnished complies with the specified requirements.

b. Mill certification for structural bolts, framing steel, roofing and siding, and steel wall liner panels.

c. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Metal Building System, a sample copy of which is attached to this section, the 20-year Manufacturer's Material Warranties, and the Manufacturer's 20-year System Weathertightness Warranty when one is required.

## SD-14 Samples

Accessories; GA.

One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roofing and Siding; GA.

One piece of each type and finish (exterior and interior) to be used, 9 inches long, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

Fasteners; GA.

Two samples of each type to be used, with statement regarding intended use.

If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation; GA.

One piece of each type to be used, and descriptive data covering installation.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample, approximately 1 pound, and descriptive data.

Wall Liners; GA.

One piece, 9 inches long, full width.

#### 1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weathertight coverings and kept dry. Storage accommodations for roofing and siding shall provide good air circulation and protection from surface staining.

#### 1.7 WARRANTIES

The Metal Building System, composed of framing and structural members, roofing and siding, gutters and downspouts, accessories, fasteners, trim, and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

##### 1.7.1 Prime Contractor's Weathertightness Warranty

The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include but is not limited to the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim, flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and

fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached **WARRANTY FOR METAL BUILDING SYSTEMS**, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

#### 1.7.2 Manufacturer's Material and/or System Weathertightness Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Contracting Officer which cover all Metal Building System components:

a. A manufacturer's 20 year material warranty warranting that the specified zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system including fasteners and coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change colors in excess of five CIE or Hunter Lab color difference ( $\Delta E$ ) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to replacing the defective coated material.

#### 1.8 COORDINATION MEETING

A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal building system contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing/metal building system manufacturer, the roofing/metal building supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting

### PART 2 PRODUCTS

#### 2.1 BUILDING COMPONENTS

Each piece or part of the assembly shall be clearly and legibly marked to correspond with the drawings.

#### 2.2 FRAMING AND STRUCTURAL MEMBERS

Steel 1/8 inch or more in thickness shall conform to ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A 570/A 570M, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 653/A 653M, G 90 coating designation, 0.045 inch minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A 792/A 792M, coating designation, 0.045 inch minimum thickness. Aluminum sheet shall conform to ASTM B 209, 0.032 inch minimum thickness. Aluminum structural shapes and tubes shall conform to ASTM B 221, or ASTM B 308/B 308M. Structural pipe shall conform to ASTM A 53, ASTM A 252, ASTM A 500, ASTM A 501, ASTM A 618, ASTM B 221, ASTM B 241/B 241M or ASTM B 429. Holes for structural connections shall be made in the shop.

## 2.3 ROOFING AND SIDING

Roofing and siding shall be steel and shall have a factory color finish.

### 2.3.1 Roofing

Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope unless otherwise approved. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place. Provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. Panel shall have configurations for overlapping sheets. Exposed, penetrating fastener may be used. Height of corrugation at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

#### 2.3.1.1 Snow Guards

Snow guards to be a low profile, traditional style and engineered for permanent installation by means of soldering or adhesive sealant to metal roof surface. Color to match roof. Refer to plans for location.

### 2.3.2 Siding

Length of sheet shall be sufficient to cover the entire height of any unbroken height of wall surface unless otherwise approved. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place. Provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. Siding shall have configurations for overlapping adjacent sheets or interlocking ribs for securing adjacent sheets. Siding shall be fastened to framework using exposed or concealed fasteners.

### 2.3.3 Steel Panels

Roofing and Siding shall be zinc-coated steel conforming to ASTM A 653/A 653M, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 E5. Panels shall be 0.024 inch thick minimum, except that when the mid field of the roof is subject to design wind uplift pressures of 60 psf or greater or the steel covering is used as a diaphragm, the entire roof system shall have a minimum thickness of 0.030 inch. Prior to shipment, mill finish panels shall be treated to inhibit the formation of oxide corrosion. Panels that have become wet during shipment but have not started to oxidize shall be dried, and retreated in accordance with manufacturer's standard practice.

#### 2.3.4 NOT USED

#### 2.3.5 NOT USED

#### 2.3.6 Factory Color Finish

Panels shall have a factory applied silicone modified polyester finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 2 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 1.0 mil thickness.

The interior color finish shall consist of the same coating and dry film thickness as the exterior. The exterior color finish shall meet the test requirements specified below.

#### 2.3.6.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blistering, as determined by ASTM D 714; and a rating of 8, 1/32 inch failure at scribe, as determined by ASTM D 1654.

#### 2.3.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

#### 2.3.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B for 1000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference ( $\Delta E$ ) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

#### 2.3.6.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.3.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

#### 2.3.6.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel base metal.

#### 2.3.6.7 Specular Gloss

Finished roof surfaces for Inspection and Residue-Turn in Buildings shall have a specular gloss value of 30 plus or minus 5 at 60 degrees when

measured in accordance with ASTM D 523.

#### 2.3.6.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

#### 2.3.7 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the roofing or siding and shall not absorb or retain water.

#### 2.4 WALL LINERS

Wall liners shall be 0.018 inch thick minimum for steel with the same composition specified for siding, and formed or patterned to prevent waviness and distortion, and shall extend from floor to the ceiling. Matching metal trim shall be provided at base of wall liner, at top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have manufacturer's standard finishes. Colors shall be selected from manufacturer's standard finishes.

#### 2.5 FASTENERS

Provide fasteners for steel wall and roof panels of zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum wall and roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be the manufacturer's standard for the system provided.

##### 2.5.1 Screws

Screws shall be as recommended by the manufacturer to meet the design strength requirements.

##### 2.5.2 End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

##### 2.5.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.

#### 2.5.4 Blind Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

#### 2.5.5 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

#### 2.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be fabricated of zinc-coated steel or aluminum-zinc alloy coated steel and shall have manufacturer's factory color finish. Minimum uncoated thickness of materials shall be 0.018 inch for steel. All accessories necessary for the complete installation of the gutters and downspouts shall be furnished. Accessories shall include gutter straps, downspout elbows, downspout straps and fasteners fabricated from metal compatible with the gutters and downspouts.

#### 2.7 LOUVERS

Louvers shall be fabricated of aluminum, zinc-coated steel, or aluminum-zinc alloy coated steel; shall have manufacturer's factory color finish; and shall be furnished with bird and insect screens. Minimum uncoated thickness of materials shall be 0.048 inch for steel. Manually operated louvers shall be designed to be opened and closed from the operating floor.

#### 2.8 NOT USED

#### 2.9 NOT USED

#### 2.10 NOT USED

#### 2.11 NOT USED

#### 2.12 DOORS

##### 2.12.1 Hinged Doors

Hinged doors and frames shall receive a galvanic coating and factory primer and shall conform to the requirements of Section 08110 STEEL DOORS AND FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as specified in Section 08700 BUILDERS' HARDWARE.

#### 2.13 NOT USED

#### 2.14 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. Roof and wall insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

## 2.14.1 NOT USED

### 2.14.1.1 Blanket Insulation

Blanket insulation shall conform to ASTM C 991.

### 2.14.1.2 Insulation Retainers

Retainers shall be type, size and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

## 2.15 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber like consistency.

## 2.16 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

## 2.17 VAPOR RETARDER

### 2.17.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 0.1 perm or less when tested in accordance with ASTM E 96. Facing shall be white sheet vinyl. Facings and finishes shall be factory applied.

### 2.17.2 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to the requirements of ASTM D 4397. A single ply of 10 mil polyethylene sheet; or, at the option of the Contractor, a double ply of 6 mil polyethylene sheet shall be used. A fully compatible polyethylene tape shall be provided which has equal or better water vapor control characteristics than the vapor retarder material. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

## PART 3 EXECUTION

Not used.

## SECTION 13206

## STEEL STANDPIPES AND GROUND STORAGE RESERVOIRS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA ANSI/AWWA C115/A21.15 (1994) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

AWWA ANSI/AWWA C151/A21.51 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C652 (1992) Disinfection of Water-Storage Facilities

AWWA D100 (1996) Welded Steel Tanks for Water Storage

AWWA D103 (1987) Factory-Coated Bolted Steel Tanks for Water Storage

## MILITARY SPECIFICATIONS (MS)

MS DOD-C-24654 (Basic) Coatings, Epoxy, Potable Water Tanks (Metric)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 22 (1996) Standard for Water Tanks for Private Fire Protection

## NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 61 (1997a) Drinking Water System Components - Health Effects (Sections 1-9)

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Design and Construction Standards

The design, fabrication, and erection of the reservoir shall be in accordance with the applicable requirements of AWWA D100 or AWWA D103 except as modified herein. Earthquake design shall be for seismic zone 1. No additional thickness for corrosion allowance will be required. The reservoir shall be designed for a peak wind speed of 100 mph and snow load of 25 psf.

### 1.2.2 Welding for Tanks

Qualification of Welding Procedures, Welders, and Welding Operators for Welded Tanks, Section 8.2 of AWWA D100.

### 1.2.3 Design Requirements

The reservoir shall have a storage capacity of 100,000 gallons. The high-water level of reservoir shall be at approximate elevation 129.0 with the top of foundation approximately at elevation 99.4. The range between high and low water levels will be approximately 30 feet. Existing grade at proposed location is approximately elevation 98.5. The reservoir shall have such standard shell height and such diameter as will meet the requirements for the selected standard capacity and for the high-water level specified above. The reservoir may have supported cone roof, or supported toriconical roof, as approved. The reservoir shall be of welded or bolted construction.

### 1.2.4 Sizing of Standpipe and Reservoir

Section 6 of AWWA D100 or Section 4 of AWWA D103.

### 1.2.5 Coatings Certification

Coating materials for interior applications and all other materials which will be in normal contact with potable water shall conform to NSF ANSI/NSF 61. Certification by an independent third-party organization that all interior coatings and materials that come in contact with potable water comply with NSF ANSI/NSF 61 shall be provided.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

General Requirements; GA. Foundations; GA.

Design analyses and calculations.

#### SD-04 Drawings

Steel Standpipes and Ground Storage Reservoirs; GA.

Detail and erection drawings, before proceeding with any fabrication. The drawings shall be complete with details of all steel, pipe, and concrete work and with details of the assembling of all items required for the complete installation. Standard welding symbols as recommended by the American Welding Society shall be used. Details of all joints referenced on the drawings shall also be included.

#### SD-09 Reports

Tank Installation; FIO. Testing of Valves and Piping; FIO.

Copies of the following test results:

- a. Manufacturer's mill test reports for plate material.
- b. Mill and shop inspections by a commercial inspection agency.
- c. After acceptance of the structure, the radiographic film and/or test segments.
- d. At the conclusion of the work, a written report prepared by the Contractor certifying that the work was inspected in accordance with Section 11 of AWWA D100 or Section 9 of AWWA D103. The report shall also cover the hydrostatic and vacuum box leak tests and shall meet the requirements of Section 11.2.1 of AWWA D100 for welded tanks.

#### SD-13 Certificates

General Requirements; GA. Foundations; GA.

Certification by an independent third-party organization that all interior coating and materials that come in contact with the potable water comply with NSF ANSI/NSF 61.

A certificate signed by a registered professional engineer, providing the following information:

- a. Description of the structural design loading conditions used for the design of entire tank including the foundation.
- b. Description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in the design.
- c. A statement verifying that the structural design has been checked by experienced engineers specializing in hydraulic structures.
- d. A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and fabricating process as prescribed by the applicable AWWA standards.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Materials shall conform to the following requirements:

#### 2.1.1 Steel and Other Tank Materials

Section 2 of AWWA D100 or Section 2 of AWWA D103.

#### 2.1.2 Shop Fabrication

Section 9 of AWWA D100 or Section 7 of AWWA D103.

#### 2.1.3 Tank Insulation

24 inch wide by full shell height panels composed of 1 1/2" thick, foil faced (both sides) isocyanurate foam insulation laminated to .024" thick 3105H25 alloy aluminum sheathing. Sheathing shall be prefinished with a

baked polyester stucco embossed finish. R-value for thickness required shall be a minimum of 10.8 at 75 deg. mean temperature.

#### 2.1.4 Ductile-Iron Pipe

Pipe shall be ductile-iron pipe except for overflow piping. Pipes, fittings and specials shall conform to the requirements of ductile-iron pipe specified in Section 02660 WATER DISTRIBUTION SYSTEM and the paragraphs below:

##### 2.1.4.1 Pressure Ratings

Flanged pipes, fittings and specials shall conform to the applicable portions of AWWA ANSI/AWWA C110/A21.10, AWWA ANSI/AWWA C115/A21.15, and AWWA ANSI/AWWA C151/A21.51 for working pressure not less than 150 psi unless otherwise shown or specified.

##### 2.1.4.2 Joints

Grooved and shouldered joints shall not be used.

#### 2.1.5 Valves

Valves shall conform to the applicable requirements specified in Section 02510 WATER DISTRIBUTION SYSTEM. In addition, the supply to the reservoir shall be controlled by a 2 inch altitude valve, automatic in operation and accurately set to prevent overflow of the reservoir. The valve shall have flanged ends and a heavy cast iron body, shall be bronze fitted with renewable cups and seats, and shall be designed without metal-to-metal seats. The valve shall be cushioned when opening and closing to prevent water hammer or shock. Valves shall be provided with a travel indicator.

#### 2.1.6 Pressure Gauge

Pressure gauge of the direct-reading type, equipped with a shutoff cock, shall be provided, in the pumphouse, on the tank side and on the discharge side of the check or altitude valve. Gauges shall have 6 inch dials, shall be stem mounted, and shall conform to ASME B40.1. Accuracy of gauges shall be Grade A or better. Gauges shall be calibrated in pounds per square inch in not more than 2 pound increments form 0 to 50 pounds in excess of the normal operating pressure at the tank.

#### 2.1.7 Tank Heating Requirements

Refer to Specification Section 15836 WATER STORAGE TANK HEATERS.

### 2.2 ASSEMBLIES

#### 2.2.1 Tank Accessories

Section 7 of AWWA D100 or Section 5 of AWWA D103 and as hereinafter specified. Additional requirements for accessories are as follows:

##### 2.2.1.1 Manholes and Pipe Connections

Section 7 of AWWA D100 and Section 5 of AWWA D103 represent the minimum requirements. Number, type, location, and size of manholes and pipe connections will be as shown on the drawings. Inlet pipe shall be over-the-top type and shall be provided with deflectors. Outlet pipe connections to extend a minimum of 12 inches above tank bottom and shall be provided with vortex breakers as shown in NFPA 22.

##### 2.2.1.2 Overflow

The overflow for the tank shall consist of an overflow weir and outside

drop pipe, adequately supported and capable of discharging at a rate of 70 gpm without the water level exceeding the tangent line of the top of the shell. The weir shall be located as directed. The overflow pipe shall be steel, ASTM A 53 or equal, and shall terminate one to two feet above grade and shall be fitted with a flapper valve to prevent ingress of animals and insects.

#### 2.2.1.3 Vent

Vent shall be welded or bolted to the cover plate of the center manhole on the roof. Vent will be tank manufacturer's standard type mushroom vent with aluminum bird screen. The free area of the vent shall be sized 50 percent in excess of the 70 gpm pump-in rate and 1250 gpm pump-out rate. Screening for vent shall conform to Section 7.7.2 of AWWA D100 or Section 5.7.2 of AWWA D103 which ensures fail-safe operation in the event that screen frosts over and the bottom of the screen shall be sufficiently elevated for snow considerations in the area.

#### 2.2.1.4 Ladders and Safety Devices

Ladders and safety devices shall be provided in accordance with Sections 7.4 and 7.5 of AWWA D100 or Sections 5.4 and 5.5 of AWWA D103. Location of ladders shall be as shown on the drawings. Sections 7.4 and 7.5 of AWWA D100 and Sections 5.4 and 5.5 of AWWA D103 represent the minimum requirement. In addition, safety cage, rest platforms, roof ladder handrails, and other safety devices shall be provided as required by federal or local laws or regulations.

#### 2.2.1.5 Scaffold Cable Support

Provision shall be made for the attachment of a scaffold cable support at the top of the roof on welded tanks.

#### 2.2.2 Anchors

The following requirements shall be met:

- a. An adequate number of anchors designed to prevent overturning of the reservoir when empty shall be installed. If anchor bolts are used, the nominal diameter shall not be less than one inch, plus a corrosion allowance of at least 1/4 inch on the diameter. If anchor straps are used, they shall be pre-tensioned before welding to the tank shell.
- b. The anchor bolts shall be a right angle bend, hook, or plate washer, while anchor straps shall have only a plate welded to the bottom. The anchors shall be inserted into the foundation to resist the computed uplift.
- c. Attachment of anchors to the shell shall not add significant localized stresses to the shell. The method of attachment shall consider the effects of deflection and rotation of the tank shell. Anchors shall not be attached to the tank bottom. Attachment of the anchor bolts to the shell shall be through stiffened chair-type assemblies or anchor rings of adequate size and height.

### PART 3 EXECUTION

#### 3.1 FOUNDATIONS

Foundations for the reservoir shall be constructed on concrete, reinforced where necessary, and designed in accordance with Section 12 of AWWA D100 or Sections 11 and 8.5 of AWWA D103 for earth with a bearing value of 2500 psf, and shall be constructed in conformance with the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE, except as shown or

specified herein. An AWWA D100 Type 1 or an AWWA D103 Type 1 or Type 2 foundation shall be provided for the reservoir. Factor of safety on overturning of reservoir under design wind load shall be 1.33 minimum. When a footing is required, an inverted truncated pyramid of earth with 2 on 1 side slopes above top of footing may be used in determining overturning stability.

### 3.2 EXCAVATING, FILLING, AND GRADING

Excavating, filling, and grading shall conform to the applicable requirements of Section 02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

### 3.3 CATHODIC PROTECTION

Cathodic protection shall conform to Section 13100.

### 3.4 NOT USED

### 3.5 NOT USED

### 3.6 TANK INSTALLATION

Tank installation shall be in accordance with the following requirements:

#### 3.6.1 Welding

Section 8 of AWWA D100 or Section 6 of AWWA D103.

#### 3.6.2 Erection

Section 10 of AWWA D100 or Section 8 of AWWA D103.

#### 3.6.3 Inspections and Testing

Tank inspections and testing shall be in accordance with Section 11 of AWWA D100 or Section 9 of AWWA D103. Mill and shop inspections shall be performed by an approved commercial inspection agency. Radiographic inspections of the welded tank shell shall be performed by the Contractor. The Contractor shall perform the hydrostatic test and the vacuum box leak test of the tank bottom. Final leak test and hydrostatic test shall be performed before painting of welded tanks.

### 3.7 TANK INSULATION INSTALLATION

Secure internal attachment system of 1/4" diameter 7 x 19 galvanized wire ropes around tank shell, tension, and secure with high strength strand links. Locate cables on 3'-0" vertical centers.

Provide male and female standing seam flanges with factory roll-formed edges on both long sides of the panels. Join and seal panels mechanically in the field to form a double folded (1") high flexible, weathertight standing seam.

Secure vertical panels to the internal cables with stainless steel slips incorporated into the panel seam and tied to each crossing internal cable.

All manways, nozzle, brackets, vents and stairways shall have panels cut tight against them and shall be sealed with PSI 7000 polysulfide rubber sealant or equal.

### 3.8 PIPING INSTALLATION

Piping installation (except for overflow piping):

### 3.8.1 General Guidelines

Where details of fabrication or installation are not shown on the drawings, installation shall conform to AWWA C600.

### 3.8.2 Testing of Valves and Piping

After the reservoir has been erected and the valves and piping installed, and before field painting is begun, the valves and piping shall be hydrostatically tested in accordance with Section 4 of AWWA C600. The Contractor shall replace with sound material any defective material disclosed by the pressure test, and the test shall be repeated until the test results are satisfactory.

### 3.8.3 NOT USED

### 3.8.4 Plugging Ends

Pipe ends left for future connections shall be capped or plugged as directed.

## 3.9 PAINTING AND COATING OF TANK

Coating materials shall be delivered to the job site in their original containers bearing the manufacturer's name, product number, and volatile organic compound (VOC) content (grams per liter). Material Safety Data Sheets (MSDS) shall be provided for coatings.

### 3.9.1 Welded Tanks

#### 3.9.1.1 Exterior Surfaces

A prime coat a minimum of 2.0 mil thick followed by two coats of alkyd enamel, each a minimum of 1.5 mil thick. The prime coat shall be rust inhibitive red iron oxide, zinc oxide, oil and alkyd primer without lead or chromate pigments, in accordance with SSPC Paint 25. The finish coats shall be white alkyd enamel in accordance with Type I of SSPC Paint 104.

#### 3.9.1.2 Interior Surfaces

A prime coat at least 3.0 mil thick and a white final coat at least 5.0 mil thick. Each coat shall be a two-component catalyzed epoxy in accordance with MS DOD-C-24654. The primer shall contrast with the color of the finish coat.

### 3.9.2 Bolted Tanks

The tanks shall have a coating applied to both the interior and exterior surfaces in accordance with Section 10 of AWWA D103. Color shall be as approved.

## 3.10 DISINFECTION

The reservoir and connecting lines thereto shall be disinfected with chlorine before being placed in operation.

### 3.10.1 Tank

The reservoir shall be disinfected by the Contractor in accordance with AWWA C652. After the chlorination procedure is completed and before the storage facility is placed in service, the Contracting Officer will collect samples of water in properly sterilized containers for bacteriological testing from the full facility in accordance with paragraph 4.4.3 of AWWA C652. The tank will not be accepted until satisfactory bacteriological results have been obtained.

3.10.2 Piping

The valves and piping shall be disinfected by the Contractor in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

-- End of Section --

## SECTION 13850

## FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41 (1990) Audible Emergency Evacuation Signals

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 72 (1996) National Fire Alarm Code

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

## UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 38 (1994; Rev Jan 1994) ) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 268 (1996) Smoke Detectors for Fire Protective Signaling Systems

UL 268A (1993; Rev thru May 1997) Smoke Detectors for Duct Applications

UL 464 (1996) Audible Signal Appliances

UL 521 (1993; Rev Oct 1994) Heat Detectors for Fire Protective Signaling Systems

UL 797 (1993; Rev thru Mar 1997) Electrical Metallic Tubing

UL 864 (1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems

UL 1242 (1996) Intermediate Metal Conduit

UL 1971 (1995; Rev thru May 1997) Signaling Devices for the Hearing Impaired

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

### 1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

### 1.2.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

### 1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

### 1.2.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.2.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

### 1.2.7 Qualifications

#### 1.2.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

#### 1.2.7.2 Installer

The installing Contractor shall provide the following: Fire Alarm Technicians to perform the installation of the system. A Fire Alarm Technician with a minimum of 4 years of experience shall perform/supervise the installation of the fire alarm system. Fire Alarm technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

#### 1.2.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an

individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.
- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.
- d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers

### 1.3 SYSTEM DESIGN

#### 1.3.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, or NAC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

#### 1.3.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of alarm IDC and NAC. Smoke detectors shall not have combined alarm initiating and power circuits.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. A trouble buzzer and trouble light emitting diode (LED) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.
- h. Confirmation or verification modules for smoke detection initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices, other than smoke detectors, will be prohibited on circuits controlled by confirmation or verification modules.
- i. The fire alarm control panel shall provide supervised relays for HVAC shutdown. An override at the HVAC panel shall not be provided.
- j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- k. Zones for alarm IDC and NAC shall be arranged as indicated on the contract drawings.
- l. The fire alarm control panel shall be readily capable of future expansion and modification by qualified technicians. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

### 1.3.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of signals over the station radio fire reporting system. The signals shall be different for each zone.
- b. Visual indications of the alarmed zones on the fire alarm control panel annunciator.
- c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

### 1.3.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

#### 1.3.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

#### 1.3.6 NOT USED

#### 1.3.7 Interface With Other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

### 1.4 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

- (1) Identification of programmable portions of system equipment and capabilities.
- (2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- (3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.
- (4) Description of Fire Alarm Control Panel equipment operation.
- (5) Description of auxiliary and remote equipment operations.
- (6) Library of application software.
- (7) Operation and maintenance manuals described under SD-19 in the SUBMITTALS paragraph.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FI0" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Storage Batteries; GA.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; GA.

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts; GA.

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; GA.

Technical data which relates to computer software.

#### SD-04 Drawings

Fire Alarm Reporting System; GA.

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

#### SD-13 Certificates

Equipment; GA.

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

#### SD-19 Operation and Maintenance Manuals

Technical Data and Computer Software; GA.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The instructions shall include the information provided in paragraph TECHNICAL DATA AND COMPUTER SOFTWARE. The instructions shall include complete procedures for system revision and expansion, detailing

both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Instructions shall be approved prior to training.

#### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

### PART 2 PRODUCTS

#### 2.1 CONTROL PANEL

Control panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LEDs, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble LEDs shall be provided for each zone alarm. These LEDs shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

Visual annunciators shall be provided for each active zone and spare zone.

25% spare zones shall be provided. Each LED shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic, or metal sign with either raised or engraved letters. Zone identification shall consist of a word description of the zone. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

##### 2.1.1 Remote System Trouble Audible/Visual Appliance

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel's integral trouble signal. The audible device shall be silenced by the system trouble silence switch located at the remote location, but shall not extinguish the visual indicator. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Trouble" shall be provided at the audible appliance. The visual appliance located with the audible appliance shall not be extinguished until the trouble has been cleared.

##### 2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

##### 2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

## 2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

## 2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

## 2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on surface for finished areas and semi-flush for unfinished mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

## 2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Installed devices shall conform to the NFPA 70 hazard classification of the area where devices are to be installed.

### 2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as shown on drawings, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 70 by 70 ft.

#### 2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization type. Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED suitable for mounting in a finished, visible location.

##### 2.5.2.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector shall be capable of withstanding ambient air velocity up to 300 fpm in accordance with UL 268.

##### 2.5.2.2 NOT USED

##### 2.5.2.3 NOT USED

##### 2.5.2.4 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

## 2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

### 2.6.1 NOT USED

### 2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted projector, type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 87 dBA at 10 feet in general use areas and 93 dBA at 10 feet in hazardous rated areas. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

### 2.6.3 NOT USED

### 2.6.4 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 95 candela. Strobe shall be surface mounted in finished areas and semi-flush mounted in unfinished areas.

### 2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units, except that they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

### 2.7 NOT USED

## 2.8 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

### 2.8.1 NOT USED

### 2.8.2 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

### 2.8.3 Wiring

Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for Fire Alarm circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.

#### 2.8.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

##### 3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

##### 3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

##### 3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

##### 3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling,

raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

### 3.1.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

### 3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

### 3.1.7 Supervisory and Alarm Contacts

Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as identified in NFPA 72 and as indicated on the drawings. Contacts shall be provided in accordance with other sections of the specifications and specific instructions on corresponding drawings. Section 13930 WET PIPE SPRINKLER SYSTEM, 13945 PREACTION AND DELUGE SYSTEMS, FIRE PROTECTION.

## 3.2 OVERVOLTAGE AND SURGE PROTECTION

### 3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

### 3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

## 3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

## 3.4 NOT USED

## 3.5 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

### 3.5.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be

retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

### 3.5.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault.
- k. Short circuit faults.
- l. Stray voltage.
- m. Loop resistance.

### 3.6 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --

## SECTION 13920

## FIRE PUMPS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 193/A 193M	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 795	(1996) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 42	(1996) Seamless Copper Pipe, Standard Sizes
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 135	(1996) Seamless Brass Tube
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM F 436	(1993) Hardened Steel Washers

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1986; R 1994) Malleable Iron Threaded

## Pipe Unions Classes 150, 250, and 300

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C500	(1993; C500) Metal-Sealed Gates Valves for Water Supply Service

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1996; Errata; TIA 96-1) Installation of Centrifugal Fire Pumps
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 37	(1997) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1996; Errata 96-4) National Electrical Code
NFPA 1963	(1993) Fire Hose Connections

## UNDERWRITERS LABORATORIES (UL)

UL 80	(1996) Steel Inside Tanks for Oil-Burner Fuel
UL 142	(1993; Rev Apr 1995) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 262	(1994; Rev thru Apr 1997) Gate Valves for Fire-Protection Service
UL 448	(1994; Rev Jun 1995) Pumps For Fire-Protection Service
UL 1247	(1995; Rev thru May 1997) Diesel Engines

## For Driving Centrifugal Fire Pumps

UL Fire Prot Dir

(1997) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Product

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the jobsite.

## 1.2.2 Description

Fire pump, piping and associated equipment shall be provided complete and ready for operation. The fire pump shall be horizontal centrifugal fire pump. The fire pump shall be diesel engine driven fire pump. Fire pump, appurtenances and installation shall conform to NFPA 20, unless more stringent requirements are specified herein or are indicated on the drawings. In NFPA 20, the advisory provisions including those listed in the appendix shall be considered mandatory; reference to the authority having jurisdiction shall be interpreted to mean the Contracting Officer. Devices and equipment for fire protection service shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b.

## 1.2.3 Sequence of Operation

## 1.2.3.1 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 80 psi. Pump shall automatically stop when the system pressure reaches 90 psi and after the pump has operated for the minimum pump run time specified herein.

## 1.2.3.2 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 75 psi. The fire pump shall continue to run until manually shut down.

## 1.2.4 Safety Requirements

Coupling, rotating parts, gears, projecting equipment, etc. shall be fully enclosed or properly guarded so as to prevent possible injury to persons that come in close proximity of the equipment. The Contractor shall conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

## 1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work and verify all dimensions in the field. The Contractor shall notify the Contracting Officer of any discrepancy before performing the work.

## 1.2.6 Electrical Work

Electric motor and controls shall be in accordance with NFPA 20 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 16415 ELECTRICAL WORK, INTERIOR.

### 1.2.7 Factory Tests

Fire pump shall be tested by the manufacturer before shipment to provide detailed performance data and to demonstrate its compliance with the specifications.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Unless otherwise indicated, 6 copies of each item shall be submitted. Submittals, except Fire Protection Engineer's Qualifications shall be submitted concurrently as a complete package. Each submittal shall be certified in writing by the Fire Protection Engineer. The Fire Protection Engineer shall certify that the submittal is complete, that the equipment and equipment arrangement meets contract requirements, and that the proposed system is coordinated and compatible with all other equipment connected to the system, the physical space, and the power sources. The Fire Protection Engineer shall sign and date all shop drawing submittal sheets and revisions. The submittal will be reviewed by the U.S. Army Engineer District Fire Protection Engineer.

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

#### SD-01 Data

Equipment; GA.

Manufacturer's catalog data for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

- a. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.
- b. Pressure maintenance pump and controller.
- c. Piping and fittings.
- d. Valves, including gate, check, globe and relief valves.
- e. Gauges.
- f. Hose valve manifold test header and hose valves.
- g. Flow meter.
- h. Restrictive orifice union.
- i. Associated devices and equipment.

Final Test; GA.

A written request for scheduling of the final test at least 15 days prior to the date that the final acceptance test is to take place and after successful completion of the preliminary tests.

#### SD-04 Drawings

Pump Room, Equipment and Piping; GA.

Detailed drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

- a. Fire pumps, controllers, piping, valves, and associated equipment.
- b. Sensing line for each pump including the jockey pump.
- c. Engine fuel system for diesel driven pumps.
- d. Engine cooling system for diesel driven pumps.
- e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
- f. Restraint of underground water main at exit-point to the building.

A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

As-Built Drawings; FIO.

Detailed drawings updated to reflect as-built conditions after all associated work is completed, on reproducible full-size mylar film, no later than 10 working days after completion of the Final Tests. Each as-built drawing shall have a title block similar to the contract drawings.

SD-06 Instructions

Framed Instructions; FIO.

Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for safe operation, sequence of operation, and procedures for safely starting and stopping the system, prepared in typed form, framed under glass or in laminated plastic. Instructions shall be posted where directed by the Contracting Officer. Wiring and control diagrams showing the complete layout of the entire system shall be framed under glass or in approved laminated plastic and posted near each controller as directed by the Contracting Officer. Proposed instructions, diagrams and other sheets shall be submitted for approval prior to posting. Framed instructions shall be posted before acceptance testing of the system.

SD-09 Reports

Field Tests; GA.

Test reports in booklet form showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches.

The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

#### SD-13 Certificates

Engineer's Qualifications; FIO.

Prior to all other submittals, certification that the Fire Protection Engineer is a registered Fire Protection Engineer or a Registered Engineer who has had at least 4 years experience in fire protection and fire pump installation design.

Preliminary Test; GA.

A signed and dated certificate that preliminary tests have been conducted, and that the fire pump installation is complete and ready to be placed in operation, prior to submitting a formal request for a final inspection and test. The certificate shall include the names, companies, phone numbers, and titles of persons conducting and witnessing the test, including the required manufacturer's representatives. Complete test procedures, as well as results and readings taken during the preliminary tests shall be included.

Piping; FIO.

A signed statement from the piping manufacturer certifying that the piping meets requirements specified. The statement shall be signed and dated after the award of this contract, shall include the name of the project, and shall list the specific requirements which are being certified.

#### SD-18 Records

Test Procedures; GA.

Detailed test procedures for testing the fire pump system, 60 days prior to performing the pump tests.

#### SD-19 Operation and Maintenance Manuals

Fire Pumps; GA.

Operating instructions outlining step-by-step procedures required for fire pump startup, operation and shutdown shall be provided. The instructions shall include the manufacturer's name, model number, catalog cuts, diagrams, drawings, parts list, and descriptive data covering the proper operation and testing.

Six complete copies of maintenance instructions listing routine maintenance procedures and frequencies, possible breakdowns and repairs, troubleshooting guides, a complete list of parts and current sources, and recommended spare parts to be kept on hand. The instructions shall include simplified diagrams for the system as installed.

### 1.4 MANUFACTURER'S SERVICES

The Contractor shall obtain the services of the fire pump manufacturer, the fire pump controller manufacturer, and the diesel engine driver manufacturer or their representative. The persons providing this service shall be factory-trained, shall be experienced in the installation, adjustment, and operation of the equipment and shall supervise the installation, the adjustments, and the testing of equipment. The persons providing the manufacturer service shall be present during the preliminary and final tests and shall assist in the testing of the equipment.

## 1.5 DELIVERY AND STORAGE

Equipment delivered to the site or placed in storage shall be protected from weather, humidity and temperature variations, dirt, dust, and other contaminants.

## PART 2 PRODUCTS

### 2.1 FIRE PUMP

Fire pump shall be diesel engine driven. Each pump capacity shall be rated at 1250 gpm with a rated net pressure of 80 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal horizontal split case fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

### 2.2 NOT USED

### 2.3 DIESEL ENGINE DRIVER

Diesel engine driver shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Driver shall be of the make recommended by the pump manufacturer. The engine shall be closed circuit, liquid-cooled with raw water heat exchanger. Diesel engine shall be electric start type taking current from 2 battery units. Engine shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gauge, lubricating oil pressure gauge, water temperature gauge, and ammeter gauge. Engine shall be connected to horizontal-shaft pump by flexible couplings. For connections to vertical-shaft fire pumps, right-angle gear drives and universal joints shall be used.

#### 2.3.1 Engine Horsepower

Engine shall have adequate horsepower to drive the pump at all conditions of speed and load over the full range of the pump performance curve. The horsepower rating of the engine driver shall be as recommended by the pump manufacturer and shall be derated for temperature and elevation in accordance with NFPA 20. Ambient temperature at the pump location shall be 99 degrees F. Site elevation shall be 172 feet above mean sea level (MSL).

#### 2.3.2 Exhaust System External to Engine

Exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler shall be provided for each diesel engine driver to reduce noise levels less than 95 dBA. A flexible connector with flange connections shall be provided at the engine. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 1000 degrees F.

##### 2.3.2.1 Steel Pipe and Fittings

ASTM A 53, Schedule 40, black steel, welding end connections. ASME B16.9 or ASME B16.11 welding fittings shall be of the same material and weight as the piping.

##### 2.3.2.2 Flanges

ASME B16.5, Class 300. Flanges shall be provided at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 0.0625 inch thick. ASTM A 193/A 193M, Grade B8

bolts and ASTM A 194/A 194M, Grade 8 nuts shall be provided.

#### 2.3.2.3 Piping Insulation

Products containing asbestos will not be permitted. Exhaust piping system including the muffler shall be insulated with ASTM C 533 calcium silicate insulation, minimum of 3 inches thick. Insulation shall be secured with not less than 0.375 inch width Type 304 stainless steel bands spaced not more than 8 inches on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.016 inches, a factory-applied polyethylene and kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 0.5 inch wide stainless steel bands, spaced not less than 8 inches on centers. Longitudinal and circumferential seams of the jacket shall be lapped not less than 3 inches. Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

#### 2.4 NAMEPLATES AND MARKINGS

Pump and motor shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

#### 2.5 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F. The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

##### 2.5.1 NOT USED

##### 2.5.2 Controller for Diesel Engine Driven Fire Pump

Controller shall be equipped with two battery chargers; two ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller shall be equipped with the following supervisory alarm functions:

- a. Engine Trouble (individually monitored)
  - (1) Engine overspeed
  - (2) Low Oil Pressure
  - (3) High Water Temperature

- (4) Engine Failure to Start
- (5) Battery
- (6) Battery Charger/AC Power Failure
- b. Main Switch Mis-set
- c. Pump Running
- d. Pump Room Trouble (individually monitored)
  - (1) Low Fuel
  - (2) Low Pump Room Temperature
  - (3) Low Reservoir Level

Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, pump running, engine trouble and pump room trouble; and terminals for remote start. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset. When low water tank level signal is received, the controller shall cause the engine to shut down without time delay. Refer to Section 15950 for tank level sensing.

## 2.6 BATTERIES

Batteries for diesel engine driver shall be sealed lead acid or lead calcium batteries. Batteries shall be mounted in a steel rack with non-corrosive, non-conductive base, not less than 12 inches above the floor.

## 2.7 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inch H58 brass tubing complying with ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch orifice. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged per NFPA 20. One of the test connections shall be equipped with a 0 to 200 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

## 2.8 PRESSURE MAINTENANCE (JOCKEY) PUMP

Pressure maintenance pump shall be electric motor driven, horizontal shaft or in-line vertical shaft, centrifugal type with a rated discharge of 10 gpm at 90 psig. Pump shall draft as indicated and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type

shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

#### 2.8.1 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely terminally wired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

#### 2.9 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

Fuel system shall be provided that meets all requirements and advisory provisions of NFPA 20 and NFPA 37. The fuel tank vent piping shall be equipped with screened weatherproof vent cap. Vents shall be extended to the outside. Each tank shall be equipped with a fuel level gauge. Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be steel piping, except supply and return piping may be copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill cap shall be able to be locked by padlock. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. The bottom of the tank shall be pitched 1/4 inch per foot to the side opposite the suction inlet connection, and to an accessible 1 inch plugged globe drain valve.

##### 2.9.1 Steel pipe

ASTM A 53, hot-dipped zinc-coated, Schedule 40, threaded connections. Fittings shall be ASME B16.3, zinc-coated, threaded malleable iron fittings. Unions shall be ASME B16.39 zinc-coated, threaded unions.

##### 2.9.2 Copper Tubing

ASTM B 88, Type K, soft annealed, with ASME B16.26 flared fittings.

##### 2.9.3 Diesel Fuel Tanks

UL 80 or UL 142 for aboveground tanks.

##### 2.9.4 Valves

An indicating and lockable ball valve shall be provided in the supply line adjacent to the tank suction inlet connection. A check valve shall be provided in fuel return line. Valves shall be suitable for oil service. Valves shall have union end connections or threaded end connections.

- a. Globe valve: MSS SP-80 Class 125

- b. Check valve: MSS SP-80, Class 125, swing check
- c. Ball valve: Full port design, copper alloy body, 2-position lever handle.

## 2.10 PUMP BASE PLATE AND PAD

A common base plate shall be provided for each horizontal-shaft fire pump for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 1 inch galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 4 inch reinforced concrete pad that is an integral part of the reinforced concrete floor.

## 2.11 ABOVEGROUND WATER PIPING

### 2.11.1 Pipe Sizes 2.5 Inches and Larger

#### 2.11.1.1 Pipe

Piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inches and greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside per NFPA 20.

#### 2.11.1.2 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

#### 2.11.1.3 Gaskets

Gaskets shall be AWWA ANSI/AWWA C111/A21.11, cloth inserted red rubber gaskets.

#### 2.11.1.4 Bolts

Bolts shall be ASTM A 193/A 193M, Grade B8. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

#### 2.11.1.5 Nuts

Nuts shall be ASTM A 194/A 194M, Grade 8.

#### 2.11.1.6 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provide under all bolt heads and nuts.

### 2.11.2 Piping Sizes 2 Inches and Smaller

#### 2.11.2.1 Steel Pipe

Steel piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Fittings shall be ASME B16.39, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated

unions.

#### 2.11.2.2 Copper Tubing

Copper tubing shall be ASTM B 88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B 42 copper pipe with threaded end connections.

#### 2.11.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

#### 2.11.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire protection service. Valves shall have flange or threaded end connections.

##### 2.11.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

##### 2.11.4.2 Tamper Switch

The suction control valves, the discharge control valves, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

##### 2.11.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

##### 2.11.4.4 Relief Valve

Relief valve shall be pilot operated or spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

##### 2.11.4.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

#### 2.12 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b bronze hose gate valves with 2.5 inch American National Fire Hose Connection Screw Standard Threads (NH) per NFPA 1963. The number of valves shall be per NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 feet and no less than 2 feet above grade.

#### 2.13 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825bas flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. The flow meter shall be arranged in accordance with Figure A-2-14.2.1 of NFPA 20.

The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Automatic air release shall be provided if flow meter test discharge is piped to the pump suction and forms a closed-loop meter arrangement as defined in Figure A-2-14.2.1 of NFPA 20.

#### 2.14 PIPE SLEEVE

A pipe sleeve shall be provided at each location where piping passes through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Sleeves shall be grouted in position during construction. Sleeve shall be of sufficient length to pass through the entire thickness of the wall, ceilings, roofs and floors. Not less than 1 inch clearance shall be provided between pipe exterior surface and the interior of the sleeve, and between the tie rods and the interior of the sleeve. The space shall be firmly packed with mineral wool insulation and caulk at both ends with plastic waterproof cement which will dry to a firm but pliable mass, or with a segmented elastomeric seal. Where pipes pass through fire walls or fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07270 FIRESTOPPING. Sleeves in masonry and concrete walls, ceiling, roofs and floors shall be hot-dip galvanized steel, ductile-iron, or cast-iron. Other sleeves shall be galvanized steel sheet pipe not less than 0.90 psf.

#### 2.15 ESCUTCHEON (WALL) PLATES

Escutcheon plates shall be one-piece or split-hinge type metal plates and shall be provided for piping passing through floors, walls, and ceiling in exposed areas. In finished areas, plates shall be polished stainless steel or chromium-plated finish on copper alloy. In unfinished areas, plates shall have painted finish. Plates shall be secured in position.

#### 2.16 UNDERGROUND PIPING

##### 2.16.1 Pipe and Fittings

Underground piping and piping under the building slab shall be ductile-iron pipe and fittings. Piping shall be AWWA ANSI/AWWA C151/A21.51 ductile-iron pipe with AWWA ANSI/AWWA C110/A21.10 fittings and shall conform to NFPA 24. Piping beyond 5 feet of the building shall be provided under Section 02660 WATER DISTRIBUTION SYSTEM.

##### 2.16.2 Valves

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation.

##### 2.16.2.1 Valve Boxes

Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

##### 2.16.3 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and

lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavement.

## 2.17 CHLORINATING AGENTS

Chlorinating agent must comply with one of the following.

### 2.17.1 Liquid Chlorine

AWWA B301

### 2.17.2 Calcium Hypochlorite and Sodium Hypochlorite

AWWA B300

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

### 3.2 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

#### 3.2.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

#### 3.2.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D 3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

#### 3.2.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

##### 3.2.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 10 foot intervals.

##### 3.2.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	MAXIMUM SPACING (FEET)									
	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.2.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. Concrete thrust block shall be provided at elbow where pipe turns up towards floor, and the pipe riser shall be restrained with steel rods from the elbow to the flange above the floor. After installation per NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contracting Officer. Minimum depth of cover shall be 3 feet.

3.3 ELECTRICAL WORK

Except as modified herein, interior wiring methods shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR; exterior wiring methods shall be in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEMS, UNDERGROUND or Section 16370 ELECTRICAL DISTRIBUTION SYSTEMS, AERIAL as appropriate.

3.4 FIELD PAINTING AND FINISHING

Field painting and finishing shall conform to the requirements specified in Section 09900 PAINTING, GENERAL. Piping shall be provided with plastic labels of standard manufacture to identify piping as FIRE PUMP DISCHARGE, FIRE PUMP SUCTION, FIRE PUMP BYPASS, FIRE PUMP TEST HEADER, TO SYSTEM, and RELIEF VALVE DISCHARGE. Labels shall have red letters 1 inch high, 1/4 inch brush stroke, on white background.

3.5 INSTRUCTING OPERATING PERSONNEL

Upon completion of the work and at a time designated by the Contracting Officer, the Contractor shall provide, for a period of not less than one 8-hour working day, the services of experienced technicians regularly employed by the manufacturer of the fire pump, the fire pump controller, and the pump drivers to instruct Government operating personnel in the proper operation, inspection, testing, and maintenance of the equipment. Manufacturer's representatives who were present during the final tests shall be present and shall conduct or assist in the instruction.

3.6 FLUSHING

The fire pump suction and discharge piping shall be flushed at 120 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 120 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Flushing operations shall continue until water is clear, but not less than 10 minutes. The Contractor shall submit a signed and dated flushing certificate before requesting field testing.

3.7 FIELD TESTS

### 3.7.1 Hydrostatic Test

Piping shall be hydrostatically tested at 225 psig for a period of 2-hours, or at least 50 psi in excess of the maximum pressure, when the maximum pressure in the system is in excess of 175 psi.

### 3.7.2 Preliminary Test

The fire pump manufacturer, the fire pump controller manufacturer, and the diesel engine manufacturer (when supplied) or their representative shall witness the complete operational testing of the fire pump and drivers. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. All test results and readings shall be recorded during the tests and signed by the witnessing manufacturer's representative.

### 3.7.3 Final Test

The District Fire Protection Engineer and Fort Dix Fire Prevention Bureau will witness the final tests. The Contractor shall take all readings and measurements. An experienced technician regularly employed by the pump installer shall be present during the test. The pump manufacturer, the fire pump controller manufacturer, and the diesel engine manufacturer (when supplied), or their representative shall be present for the final tests. Where pumps are diesel driven, an experienced technician employed by the engine manufacturer capable of demonstrating engine trouble alarms and operating features shall be present. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test. The final acceptance test shall include the following:

#### 3.7.3.1 Inspection

Thorough inspection of the fire pump installation, including visual observation of the pump while running shall be conducted. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards.

#### 3.7.3.2 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

#### 3.7.3.3 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on

the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

#### 3.7.3.4 Battery Changeover

Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.

#### 3.7.3.5 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

#### 3.7.3.6 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

#### 3.7.4 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall performed corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

#### 3.7.5 Test Equipment

The Contractor shall provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. The Government will furnish water for the tests.

#### 3.7.6 Test Documentation

Contractor shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Contractor shall record all test results and plot curve of each pump performance during the test. The Contractor shall provide complete pump acceptance test data of each fire pump. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. The Contractor shall provide pump test data sheet in a properly labeled three ring binder.

-- End of Section --

## SECTION 13930

## WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 135	(1997) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 795	(1996) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88	(1996) Seamless Copper Water Tube

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B18.2.1	(1996) Square and Hex Bolts and Screws Inch Series
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch

## Series)

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA ANSI/AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1996; Errata 13-96-1) Installation of Sprinkler Systems
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 231C	(1995; TIA 95-1) Rack Storage of Materials
NFPA 1963	(1993) Fire Hose Connections

## NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
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## UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1998) Building Materials Directory
UL Fire Prot Dir	(1998) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation.

### 1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of .2 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

#### 1.2.1.1 Hose Demand

An allowance for exterior hose streams of 500 gpm shall be added to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building.

#### 1.2.1.2 Basis for Calculations

The design of the system shall be based upon a storage tank and fire pump water supply. The fire pump shall provide 1250 gpm at 80 psi. Water supply shall be presumed available at the Pump House Building. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing and 140 for new cement-lined ductile-iron piping.

### 1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed square feet limits specified in NFPA 13 for ordinary hazard occupancy.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package. The package will be reviewed by the U.S. Army Engineer District Fire Protection Engineer. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Load Calculations for Sizing Sway Bracing

Load calculations shall be provided for sizing of sway bracing.

Sprinkler System Equipment; GA.

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; GA.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts; FIO.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

#### SD-04 Drawings

Sprinkler System Shop Drawings; GA.

Detail drawings conforming to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

- a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.
- b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.
- c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.
- d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.
- e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Drawings; FIO.

As-built drawings, no later than 14 working days after completion of the Final Tests. The sprinkler system shop drawings shall be updated to reflect as-built conditions after work is completed and shall be on reproducible full-size mylar film.

#### SD-06 Instructions

Test Procedures; GA.

Proposed test procedures for piping hydrostatic test, testing of alarms, at least 14 days prior to the start of related testing.

## SD-07 Schedules

Preliminary Tests; GA.

A schedule of preliminary tests, at least 14 days prior to the proposed start of the tests.

Final Test; GA.

Upon successful completion of tests specified under paragraph PRELIMINARY TESTS, written notification shall be given to the Contracting Officer of the date for the final acceptance test. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

## SD-08 Statements

Installer Qualifications; GA.

Qualifications of the sprinkler installer.

Submittal Preparer's Qualifications; GA.

The name and documentation of certification of the individual who will prepare the submittals, prior to the submittal of the drawings and hydraulic calculations.

## SD-13 Certificates

Contractor's Material & Test Certificates; FIO.

Certificates, as specified in NFPA 13, shall be completed and signed by the Contractor's Representative performing required tests for both underground and aboveground piping.

## SD-19 Operation and Maintenance Manuals

Sprinkler System; GA.

Manuals shall be in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures possible breakdowns, and repairs, and troubleshooting guide. This shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

## 1.4 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software specifically designed for fire protection system design. Software which uses k-factors for typical branch lines is not acceptable. Calculations shall be taken back to the water supply source unless water supply data is otherwise indicated. Calculations shall substantiate that the design area indicated is the hydraulically most demanding. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent

pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

#### 1.5 SUBMITTAL PREPARER'S QUALIFICATIONS

The sprinkler system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014.

#### 1.6 INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

#### 1.7 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

#### 1.8 DELIVERY AND STORAGE

Equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

### PART 2 PRODUCTS

#### 2.1 GENERAL EQUIPMENT REQUIREMENTS

##### 2.1.1 Standard Products

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

##### 2.1.2 Requirements for Fire Protection Service

Equipment and materials shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory

Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

### 2.1.3 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

## 2.2 UNDERGROUND PIPING SYSTEMS

### 2.2.1 Pipe

Piping from a point 6 inches above the floor to a point 5 feet outside the building wall shall be ductile iron with a rated working pressure of 150 psi conforming to AWWA ANSI/AWWA C151/A21.51, with cement mortar lining conforming to AWWA ANSI/AWWA C104/A21.4. Piping more than 5 feet outside the building walls shall comply with Section 02510 WATER DISTRIBUTION SYSTEM.

### 2.2.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA ANSI/AWWA C110/A21.10. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA ANSI/AWWA C111/A21.11.

### 2.2.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

## 2.3 ABOVEGROUND PIPING SYSTEMS

Aboveground piping shall be steel.

### 2.3.1 Steel Piping System

#### 2.3.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black galvanized where indicated as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

#### 2.3.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

#### 2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service

and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.3.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type. Bolts shall be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

#### 2.3.2 Copper Tube Systems

##### 2.3.2.1 Copper Tube

Copper tube shall conform to ASTM B 88, Types L and M.

##### 2.3.2.2 Copper Fittings

Cast copper alloy pressure fittings shall conform to ASME B16.18 and wrought copper and bronze pressure fittings shall conform to ASME B16.22.

##### 2.3.3 NOT USED

##### 2.3.4 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized involved.

##### 2.3.5 Valves

###### 2.3.5.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

###### 2.3.5.2 Check Valve

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plates, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

#### 2.4 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

#### 2.5 WATER MOTOR ALARM ASSEMBLY

Assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 3/4 inch galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 1 inch galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

## 2.6 ALARM INITIATING AND SUPERVISORY DEVICES

### 2.6.1 NOT USED

### 2.6.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

### 2.6.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.7 FIRE DEPARTMENT CONNECTION

Fire department connection shall be projecting type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish.

The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

## 2.8 SPRINKLERS

Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Sprinklers with internal O-rings shall not be used.

### 2.8.1 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 1/2 inch or 17/32 inch orifice.

### 2.8.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed type with nominal 1/2 inch or 17/32 inch orifice. Pendent sprinklers shall have a polished chrome finish.

### 2.8.3 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a brass finish. Sidewall sprinkler shall be the quick-response type.

## 2.9 DISINFECTING MATERIALS

### 2.9.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

### 2.9.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

## 2.10 ACCESSORIES

### 2.10.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

### 2.10.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

### 2.10.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

### 2.10.4 NOT USED

### 2.10.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

## PART 3 EXECUTION

### 3.1 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 231C.

### 3.2 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

#### 3.2.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection of the piping system shall be provided in accordance with NFPA 13 and Appendix A, with the exception that the "Earthquake Zones" map of Appendix A shall not apply to this project. Seismic protection shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required in NFPA 13 for protection of piping against damage from earthquakes. Branch lines shall be equipped with sway braces at the end sprinkler head and at intervals not exceeding 30 ft.

#### 3.2.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

#### 3.2.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

#### 3.2.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

##### 3.2.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

#### 3.2.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

#### 3.2.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

#### 3.2.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

#### 3.2.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide

required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07840 FIRESTOPPING. In penetrations which are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement which will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

### 3.2.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

### 3.2.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

### 3.2.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

### 3.2.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

### 3.2.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

## 3.3 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 02510 WATER DISTRIBUTION SYSTEM.

### 3.4 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

### 3.5 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM. All wiring for supervisory and alarm circuits shall be #14 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

### 3.6 NOT USED

### 3.7 FIELD PAINTING AND FINISHING

Field painting and finishing are specified in Section 09900 PAINTING, GENERAL.

### 3.8 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.8.1 Underground Piping

##### 3.8.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

##### 3.8.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

#### 3.8.2 Aboveground Piping

##### 3.8.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

#### 3.8.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

#### 3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

#### 3.9 FINAL ACCEPTANCE TEST

Final acceptance test shall be witnessed by the Fort Dix Fire Prevention Bureau. A technician employed by the installing Contractor shall be present for the final tests and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

-- End of Section --

## SECTION 13977

## BLAST RESISTANT DOORS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 318/318R (1995) Building Code Requirements for Structural Concrete & Commentary

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA Std 9 (1990) Load Ratings and Fatigue Life for Ball Bearings

ABEMA Std 11 (1990) Load Ratings and Fatigue Life for Roller Bearings

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04 (1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AISC LFRD, Vol I (1995) Manual of Steel Construction Load & Resistance Factor Design, Vol 1 - Structural Members, Specifications and Codes

AISC LFRD, Vol II (1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II - Structural Members, Specifications

AISC ASD Manual (1989) Manual of Steel Construction Allowable Stress Design

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-02 (1996) Specification & Commentary for the Design of Cold-Formed Steel Structural Members (Part V of the Cold-Formed Steel Design Manual)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153 (1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 242/A 242M (1993a) High-Strength Low-Alloy Structural Steel

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1996) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 354	(1995) Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A 366/A 366M	(1996) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 449	(1993) Quenched and Tempered Steel Bolts and Studs
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1993) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(1994) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 534	(1994) Carburizing Steels for Anti-Friction Bearings
ASTM A 563	(1994) Carbon and Alloy Steel Nuts
ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M	(1994c) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 574	(1992a) Alloy Steel Socket-Head Cap Screws
ASTM A 588/A 588M	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1996) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1996) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 611	(1996) Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel

## Bars for Concrete Reinforcement

ASTM A 618	(1993; R 1995) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(1993) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 706/A 706M	(1995b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 715/A 715M	(1996) Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled, and Steel Sheet, Cold-Rolled, High-Strength, Low-Alloy, with Improved Formability
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(1996) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM E 90	(1996) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 568	(1995) Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F 835	(1993) Alloy Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F 883	(1990) Padlocks

## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A5.4	(1992) Stainless Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(1996) Structural Welding Code - Steel
AWS D1.3	(1989) Structural Welding Code - Sheet Steel
AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA ANSI/BHMA A156.3	(1994) Exit Devices
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BHMA ANSI/BHMA A156.4	(1992) Door Controls - Closers
BHMA ANSI/BHMA A156.8	(1994) Door Controls - Overhead Stops and Holders
BHMA ANSI/BHMA A156.13	(1994) Mortise Locks & Latches
BHMA ANSI/BHMA A156.20	(1996) Strap and Tee Hinges and Hasps

## MILITARY SPECIFICATIONS (MS)

MS MIL-H-29181	(Rev B) Hasp, High Security, Shrouded, for High and Medium Security Padlock
MS MIL-H-43905	(Rev C) Hasps, High Security Padlocks
MS MIL-P-43607	(Rev G; Am 4) Padlock, Key Operated, High Security, Shrouded Shackle

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 80A	(1996) Protection of Buildings from Exterior Fire Exposures
NFPA 101	(1997) Life Safety Code
NFPA 252	(1995) Fire Tests of Door Assemblies

## 1.2 DESCRIPTION

[Structural steel doors shall be [flush mounted in frames] [or] [surface mounted] [as indicated].] [Reinforced concrete doors shall be surface mounted.] [Hollow metal doors shall be flush mounted in frames and shall be of unitized grid construction with two face sheets.] Doors shall be the manually operated, side hinged, swinging type. Each door assembly shall include the door, frame, anchors, hardware, and accessories and shall be provided by a single manufacturer. Frames and anchors shall be capable of transferring blast and rebound reactions to the adjacent supporting structure. Resistance to blast shall be demonstrated either by design calculations or tests on prototype door assemblies.

## 1.2.1 Design Requirements

## 1.2.1.1 Static Material Strength

The static values for minimum yield strength (or yield point) and (ultimate) tensile strength for steel shall be obtained from the applicable material specification. For tensile strength specified in terms of a tensile strength range, the lowest tensile strength specified shall be selected for design. Structural steel having a minimum static yield strength (or yield point) less than 50 ksi [and Grade 60 reinforcing bars] shall be designed using an average yield strength computed as 1.1 times the minimum static yield strength or yield point. When the minimum static yield for structural steel exceeds 50 ksi, the average yield strength shall be taken as equal to the minimum static yield strength or yield point without increase. [The in-place compressive strength of concrete shall be computed by adding [0.5] [\_\_\_\_\_] ksi to the specified compressive strength to reach the average compressive strength and then multiplying by [1.1] [\_\_\_\_\_] to account for age effects.] [The average yield stress for steel sheet and strip shall be computed as 1.21 times the static yield point.]

## 1.2.1.2 Dynamic Material Strength

The dynamic material strength shall be computed by applying a dynamic increase factor that accounts for the increase in material strength due to strain rate effects. The dynamic increase factor for structural steel in flexure shall be applied to the average yield strength and shall be [1.29] [\_\_\_\_], [1.19] [\_\_\_\_], and [1.09] [\_\_\_\_] for structural steel having a minimum yield strength (or yield point) of 36, 50, and 100 ksi, respectively. The dynamic increase factor for structural steel having a minimum yield strength (or yield point) between these values shall be obtained by interpolation. Optionally, for structural steel in these yield ranges, the dynamic increase factor shall be determined by a detailed analysis that accounts for the time to yield. The dynamic increase factor for structural steel having a minimum yield exceeding 100 ksi shall be 1.0. [The dynamic increase factor for Grade 60 flexural reinforcing bars shall be [1.17] [\_\_\_\_] applied to the average yield strength. The dynamic increase factor for concrete used in flexure shall be [1.19] [\_\_\_\_] applied to the in-place compressive strength. Optionally, the dynamic increase factor applied to flexural reinforcing bar yield and concrete compressive strength shall be determined by a detailed analysis that accounts for the time to steel yield and time to ultimate concrete strength.] [The dynamic increase factor for steel sheet and strip used in flexure shall be 1.1 applied to the average yield stress.]

#### 1.2.1.3 Structural Member Design

[Structural steel section properties for rolled shapes shall be obtained from AISC LFRD, Vol I, AISC ASD Manual, or steel manufacturers' catalogs. The plastic moment capacity for single plate sections and sections built up from plates and shapes shall be computed as the average of the elastic and plastic section modulus multiplied by the dynamic yield strength, unless otherwise approved. Shear, welds, local buckling, and web crippling of structural steel shall be designed in accordance with AISC LFRD, Vol II, the plastic design provisions of AISC-04, or by other approved methods except that for blast design, the load factors and resistance factors shall be equal to 1.0 and the dynamic yield strength shall be substituted for the static yield stress.] [Nominal reinforcing bar designations, weights, and dimensions shall be obtained from ACI 318/318R or the reinforcing bar specification. The moment of inertia of the reinforced concrete cross section used to determine the elastic deflection shall be the average of the moment of inertia of the gross section and the moment of inertia of the cracked section. The resistance of the reinforced concrete section shall be computed in accordance with ACI 318/318R or other approved methods except that for blast design, the load and resistance factors shall be equal to 1.0 and the dynamic reinforcing bar yield strength and dynamic ultimate concrete strength shall be substituted for the static strength values.] [Hollow metal doors shall be designed in accordance with AISI-02 except that for blast design, the dynamic yield strength shall be substituted for the static yield point.]

#### 1.2.1.4 Dynamic Analysis and Deformation

The door shall be designed using an equivalent single degree of freedom or other approved dynamic analysis method. The maximum door deformation shall be selected by the door manufacturer except that the maximum deformation in flexure shall not exceed the deformation limits specified or indicated. The deformation of structural steel members having a minimum yield strength or yield point greater than 65 ksi shall not exceed the elastic deflection. [Increased resistance due to strain hardening of structural steel in flexure can be used when the ductility ratio exceeds 10 or when otherwise approved.] [The ductility ratio for flexural members in hollow metal doors shall not exceed 1.0.]

#### 1.2.1.5 Rebound Resistance

Rebound resistance shall be the specified or indicated percentage of the

door resistance at initial peak response.

### 1.2.2 Blast Effects

#### 1.2.2.1 Overpressure

The spatial distribution of overpressure shall be uniform unless otherwise specified or indicated. [For overpressure specified or indicated without duration, the overpressure waveform shall have a zero rise time and infinite duration.] [For overpressure specified or indicated with duration only, the waveform shall be a triangle with a zero rise time.] [Special waveforms are indicated.]

#### 1.2.2.2 Overpressure Direction

[For overpressure identified as seating and for overpressure directions not otherwise specified or indicated, the positive phase overpressure shall be in the direction that causes the door to seat toward the frame.] [For overpressure identified as unseating, the positive phase overpressure shall be in the direction that causes the door to unseat away from the frame.]

#### 1.2.2.3 Fragment Resistance

For doors specified or indicated to resist fragments, the door and the door and frame interface shall be designed to prevent fragment perforation and the latches and latching mechanism shall be shielded from fragment damage. The fragment impact point shall be anywhere on the door and frame face exposed to overpressure.

### 1.2.3 Blast Door Operation

The force required to set the door in motion shall be measured from the 90-degree open position, and the force required to engage and release the latches shall be measured at the latch handle with the door in the normal closed position.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Blast Resistant Door; GA.

Data on standard blast doors consisting of catalog cuts, brochures, circulars, specifications, and product data that show complete dimensions and completely describe overpressure ratings, rebound ratings, doors, frames, anchors, hardware, and accessories.

Contractor Design Calculations; GA.

Detailed structural analysis and design calculations demonstrating resistance to blast when blast resistance is not demonstrated by prototype tests. Design calculations shall demonstrate adequacy under the blast effects specified or indicated. Design calculations shall include a sketch of the overpressure waveform; dimensioned sketches of blast resisting elements such as door members, frame members, latches, and hinges; section properties for blast resisting members including built-up sections; the standard under which steel is produced; static and dynamic material strength properties; the resistance, stiffness, mass, elastic natural period, and elastic deflection for flexural members; and the peak deflection, peak support rotation, and time to peak deflection for door

members in flexure. Design calculations shall cover initial response, rebound, and all secondary items such as shear, welds, local buckling, web crippling, hinges, and latches.

Test on Prototype Door; GA.

Certified test reports demonstrating blast resistance. Test reports shall include the name and location of the testing agency or laboratory, a description of the testing apparatus, the date of the tests, a description of the door specimen tested, descriptions of loadings, and the value of measured peak door deflection and peak permanent set. Test reports shall include analysis and interpretation of test results.

#### SD-04 Drawings

Contractor Design of Blast Resistant Doors; GA.

For special doors or standard doors with appreciable modifications, detailed fabrication and assembly drawings indicating the door location and showing dimensions, materials, fabrication methods, hardware, and accessories in sufficient detail to enable the Contracting Officer to check compliance with contract documents. Weld symbols used shall conform to AWS A2.4. These drawings need not be submitted for standard doors for which manufacturer's catalog data is submitted.

#### SD-06 Instructions

Blast Resistant Door; FIO.

Manufacturer's instructions for installation and field testing.

#### SD-08 Statements

Manufacturer's Field Service; FIO.

Information describing training to be provided, training aids to be used, and background data on the personnel conducting the training.

#### SD-09 Reports

Blast Door Shop and Field Operating Tests; GA.

Shop and field operating test reports that include values for opening and closing forces and times, forces required to operate latches, and a description of all operating tests performed.

Fire Rated Blast Door; GA.

In lieu of a UL listing for fire door assemblies, a letter may be submitted by the testing laboratory which identifies the submitted product by manufacturer and type or model and certifies that it has tested a sample assembly and issued a current listing.

#### SD-13 Certificates

Certificates of Compliance; GA.

Steel mill reports covering the number, chemical composition, and tension properties for structural quality steels. When blast resistance is demonstrated by calculations, a certificate stating that the door assembly provided was manufactured using the same materials, dimensions, and tolerances shown in the calculations. When blast resistance is demonstrated by prototype testing, a certificate stating that door and frame provided was manufactured using the same materials, dimensions, and tolerances as the tested prototype and listing the hardware and frame

anchors required to achieve blast resistance. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturer and shall identify the door assembly and date of shipment or delivery to which the certificate applies.

Fire Rated Blast Door; GA.

Certificate of inspection conforming to NFPA 80, NFPA 80A, and NFPA 101 for fire doors exceeding the size for which label service is available.

Thermal Insulated Blast Door; GA.

Sound Rated Blast Door; GA.

Certification or test report for [thermal insulated] [sound rated] doors listing the type of hardware used to achieve the rating.

#### SD-19 Operation and Maintenance Manuals

Blast Resistant Door; FIO.

Information bound in manual form consisting of manufacturer's safety precautions, preventative maintenance and schedules, troubleshooting procedures, special tools, parts list, and spare parts data. All material shall be cross referenced to the door designations shown on the drawings.

### 1.4 QUALIFICATIONS

Welders, welding operators, and weld inspectors shall be qualified in accordance with AWS D1.1 [except that] [welders performing arc welding of steel sheet and strip shall be qualified in accordance with AWS D1.3] [and] [welders and weld operators performing welding of reinforcing bars shall be qualified in accordance with AWS D1.4].

### 1.5 DELIVERY AND STORAGE

Door assemblies delivered and placed in storage shall be stored with protection from weather and dirt, dust, and contaminants.

### 1.6 WARRANTY

Manufacturer's written warranty covering the blast door assembly for 2 years after acceptance by the Government shall be furnished. Warranty shall provide for repair and replacement of the blast door assembly and individual hardware and accessory items in the event of malfunction due to defects in design, materials, and workmanship except that the warranty need not cover finishes provided by others.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Only structural quality steel materials for which tension properties have been obtained shall be used to resist blast except that commercial quality steel sheet and strip shall be permitted for prototype tested hollow metal doors. Steel used in the door, door frame, and door frame anchors and nonstainless steel fasteners that resist blast shall be selected from the materials specified.

#### 2.1.1 Concrete and Concrete Reinforcement

Concrete is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcement shall conform to ASTM A 615/A 615M or ASTM A 706/A 706M, Grade 60.

### 2.1.2 Structural Tubing

Structural tubing shall conform to ASTM A 500, ASTM A 501, or ASTM A 618.

### 2.1.3 Structural Steel

Structural steel bars, plates, and shapes shall conform to ASTM A 36/A 36M, ASTM A 242/A 242M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Quenched and tempered steel plate shall conform to ASTM A 514/A 514M.

### 2.1.4 Steel Sheet and Strip

Steel sheet and strip shall conform to ASTM A 366/A 366M; ASTM A 653/A 653M, Grades A, B, C, D, and F; ASTM A 653/A 653M; ASTM A 570/A 570M; ASTM A 606; ASTM A 607; ASTM A 611, Grades A, B, C, and D; ASTM A 715/A 715M, Grades 50 and 60; or ASTM A 792/A 792M, Grades 33, 37, 40, and 50.

### 2.1.5 Fasteners

Steel studs and bolts shall conform to ASTM A 307, ASTM A 325, ASTM A 354, ASTM A 449, ASTM A 490, or ASTM A 687 as applicable. Steel nuts shall conform to ASTM A 563. Hardened circular, beveled, and clipped washers shall conform to ASTM F 436. Steel hex cap screws shall conform to ASTM F 568. Steel socket-headed cap screws shall conform to ASTM A 574. Steel button and flat-headed countersunk cap screws shall conform to ASTM F 835.

## 2.2 HARDWARE

### 2.2.1 Hinges

#### 2.2.1.1 General Requirements

Hinges shall be specially manufactured to support the door and to resist any blast induced loading. The number of hinges shall be determined by the blast door manufacturer. Welds used in hinges shall be continuous. Hinges shall be attached to the door and frame using mechanical fasteners except that full surface hinges for doors with locks shall be attached to the door and frame by welding or approved tamper-resistant mechanical fasteners and hinges for doors with locks shall have approved nonremovable pins. Load ratings and fatigue life for ball and roller bearings shall be determined in accordance with ABEMA Std 9 and ABEMA Std 11 as applicable and, unless otherwise approved, the bearing steel shall conform to ASTM A 534. Hinges shall be capable of operating for the minimum number of cycles specified without failure or excessive wear under the door service loads where one cycle consists of swinging the door back and forth between the normal closed position and the 90-degree open position, where failure or excessive wear means that the latches do not seat properly or the door does not swing smoothly due to hinge failure or wear, and where door service loads consist of the door weight plus any loads produced by hardware. Rolling bearings shall be factory grease lubricated and either sealed or provided with easily accessible lubrication fittings.

#### 2.2.1.1 Hinge Description

[Hinge Type 1 shall be capable of smooth operation for a minimum of 250,000 cycles. This type of hinge shall be provided with structural quality steel pins and leafs and either rolling bearings in both the thrust and radial directions or hardened steel washer (disc) thrust bearings and rolling radial bearings except that rolling thrust bearings and metallic journal radial bearings shall be permitted for hollow metal doors when the specified overpressure is less than 3 psi.] [Hinge Type 2 shall be smooth operating and shall be provided with structural quality steel pins and leafs, steel base washer (disc) thrust bearings, and metallic journal radial bearings or other approved nonrolling type bearings.] [Hinge Type 3 shall be provided with metallic bearings.]

## 2.2.2 Latching System

### 2.2.2.1 Latching Points

The number of latching points shall be determined by the door manufacturer. [For multiple latching points, latching points can be provided at the head, sill, and jambs.] [For jamb latching points, latching points shall be provided at the jambs only.]

### 2.2.2.2 Latching System Operation

Latching systems shall be capable of operating for the same number of cycles specified for the door hinges where one latch operating cycle consists of engaging and releasing using the handle. Latches shall remain engaged until manually released and shall not release under blast loads or rebound. [Manually operated latches shall remain in the released position until manually engaged.] [Self-latching latches shall provide self-activating engagement when the door is swung to the normal closed position.] Handles shall release latches under a clockwise motion.

### 2.2.2.3 Latching Mechanism

[Latching mechanisms and latches for structural steel doors shall be mounted on the seating face of the door.] [Latching mechanisms for hollow metal doors shall be mounted on the seating face of the door and safety covered.] [Unless otherwise approved, latch handle axles (spindles) for [structural steel doors] [and] [reinforced concrete doors] shall extend through the blast load carrying portion of the door and shall be provided with suitable metallic journal bearings.] Latch handle axles shall be manufactured of hardened steel or stainless steel, and axles requiring lubrication shall be provided with easily accessible lubrication fittings.

### 2.2.2.4 Safety Cover

Safety covers shall consist of steel housings that enclose the latching mechanism such that only the operating rods are exposed.

### 2.2.2.5 Cover Plate

Cover plates for structural steel doors shall be manufactured of minimum 1/4 inch thick plate and shall enclose the entire latching mechanism.

### 2.2.2.6 Latches

Latches (latch bolts) shall be manufactured of structural quality steel and the latch bolt throw shall not be less than 3/4 inch. Latch bolts shall be the sliding type in which the latch bolt slides into a matching strike in the door frame [or the lever type in which the latch bolt rotates into a groove in the frame as specified or indicated] [except that latches for doors with [mortise lock and latch sets] [and] [exit devices] shall be the sliding type]. Manually operated latches shall draw the door toward the frame during latching.

### 2.2.2.7 Handle

[Handles for doors without locks shall be manufactured of steel castings, forgings, pipe, round tubing, bar, or plate and shall be one piece or have welded joints except that wheel handles can be manufactured of aluminum castings.] [Handles for doors with mortise lock and latch sets shall be manufactured of [steel castings] [or] [stainless steel].] Latch handles shall be firmly fastened to axles. Lever handles shall be perpendicular to the door edge when latches are engaged. [Single lever handles shall be located at the stile opposite the hinges.] [[Wheel] [and spoke lever] [Spoke lever] handles shall be located approximately halfway between the

stiles.]

### 2.2.3 Mortise Lock and Latch Set

Lever handles shall release latches using a torque not exceeding 27 lb-in.

Latches (latch bolts) shall be located at the stiles and operated from a single lever handle. Only one deadbolt shall be provided. The deadbolt shall be manufactured of structural quality steel and the deadbolt throw shall not be less than 1 inch. Mortise locks shall be provided with armored fronts. The function numbers for mortise locks shall be as defined in BHMA ANSI/BHMA A156.13.

### 2.2.4 Keying

[Keying shall conform to Section 08700 BUILDERS' HARDWARE.] [Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Unless otherwise specified, two change keys shall be provided for each lock.] [Locks shall be furnished with the manufacturer's standard construction key system.]

### 2.2.5 Exit Device

Latches (latch bolts) shall release by depressing the actuation bar using a force of not more than 15 pounds applied perpendicular to the door in the swing direction. The exit device shall [conform to the finish test values specified in BHMA ANSI/BHMA A156.3 and shall be of] [be of stainless steel construction and] plain design with straight, beveled, or smoothly rounded sides, corners, and edges. A touch bar may be provided in lieu of a conventional actuation bar (cross bar). The function numbers for exit devices shall be as defined in BHMA ANSI/BHMA A156.3.

### 2.2.6 Straight Steel Bar Door Pull

Straight steel bar door pulls shall be manufactured of round steel bar. The type furnished shall be [Type I: 1/2 inch diameter, 5 inch grip and 2-1/2 inch projection with 1/2 inch inside bend radiuses] [;] [and] [Type II: 5/8 inch diameter, 12 inch grip and 4 inch projection with 15/16 inch inside bend radiuses] [; and] [Type III: 5/8 inch diameter, 8 inch grip and 4 inch projection with 15/16 inch inside bend radiuses]. Grip and projection dimensions are measured from the bar centerline. The pull shall be attached to the door by fillet welding all around.

### 2.2.7 Padlock

Low security padlocks shall conform to ASTM F 883, Type [PO1] [PO2], Option [\_\_\_\_\_] [and] [\_\_\_\_\_] , Grade [\_\_\_\_\_].

### 2.2.8 Shrouded Padlock

High security padlocks with shrouded shackles shall conform to MS MIL-P-43607.

### 2.2.9 Hasp

Low security hasps shall conform to BHMA ANSI/BHMA A156.20, Grade [1] [2] [3], steel, [safety] [or] [open hinge] type with [adjustable] [,] [or] [swivel] [,] [or] [fixed] staple, [paint finished] [or] [galvanized] [as specified] and screw fastened to the door and frame.

### 2.2.10 High Security Hasp

High security hasps shall conform to MS MIL-H-43905, Style [\_\_\_\_\_] [carbon] [corrosion resistant] steel, attached by [fasteners] [welding].

### 2.2.11 Shrouded Hasp

High security shrouded hasps shall conform to MS MIL-H-29181, Style [1] [or] [2] [as applicable].

#### 2.2.12 Door Stop

Door stops shall be designed to resist the impact of the door. The stop shall not scratch or scar the door finish when the door is opened against the stop.

#### 2.2.13 Surface Door Closer

The surface door closer shall conform to BHMA ANSI/BHMA A156.4. The size and grade shall be selected by the door manufacturer.

#### 2.2.14 Overhead Door Holder

Overhead door holder shall be surface mounted. The holder shall have a spring or other device to cushion the door action and shall limit the door swing at [85] [110] degrees. [The holder shall have a built-in, hold-open capability at the swing limit specified.] [Overhead door holders for hollow metal doors weighing less than 200 pounds shall conform to BHMA ANSI/BHMA A156.8.]

#### 2.2.15 Gasket Seal

Sealed doors shall have the full door perimeter and all door penetrations sealed. Perimeter seals shall be the rubber gasket type. Gaskets shall be removable, capable of sealing the mating surfaces, and resistant to the atmospheric environment. One spare set of gasket seals shall be provided for each door assembly for which gasket seals are specified.

#### 2.2.16 Door Silencer

Rubber door silencers shall cushion the impact of the door against the frame so that steel-to-steel contact is not made during closing.

#### 2.2.17 Optical Device

The optical device (spy hole) shall be wide angle and shall not be breached or dislodged by the specified or indicated blast overpressure. The device shall permit observation from the seating face of the door and shall be located approximately 5 feet above the seating side floor and approximately centered between the stiles.

### 2.3 ACCESSORIES

#### 2.3.1 Subframe

At the Contractor's option, a subframe can be provided and built into the structure prior to installation of the frame. The subframe and subframe anchors shall be capable of transferring blast and rebound reactions to the adjacent structure, and the frame shall be capable of transferring these reactions to the subframe. The subframe shall be fabricated in the same manner specified for the frame.

#### 2.3.2 Nameplate

Each door assembly shall have a permanently affixed nameplate that displays the manufacturer's name, place and year of manufacture, and the applicable peak overpressure, impulse, and rebound rating.

#### 2.3.3 Removable Threshold

The sill shall be flush with the adjacent floor when the threshold is

removed. The removable threshold shall be attached using approved countersunk mechanical fasteners.

#### 2.3.4 Ramp

The ramp shall be structural steel, portable, and weigh not more than [200] [\_\_\_\_\_] pounds. The ramp shall be of sufficient length to extend the full door opening width and shall have the profile indicated. The ramp shall be capable of supporting [a wheel load of [\_\_\_\_\_] pounds] [the wheel load indicated].

#### 2.3.5 Self-Rescue Kit

Self-rescue kits shall contain illustrated instructions, nonadjustable wrenches, screwdrivers, jacks, and all other tools required to open the blast door from the seating face to a width of at least 12 inches. The jack capacity shall not be less than [75,000] [\_\_\_\_\_] pounds. Tools shall be securely mounted in a steel frame using wing nuts or other approved fasteners. The self-rescue kit frame shall be fabricated in the same manner specified for the door frame and shall be securely anchored to the wall at the location indicated or as directed.

### 2.4 FABRICATION

#### 2.4.1 Shop Assembly

Welding shall be in accordance with AWS D1.1 except that arc welding of steel sheet and strip shall be in accordance with AWS D1.3 and welding of concrete reinforcing bars shall be in accordance with AWS D1.4. [Stainless steel shall be welded using electrodes conforming to AWS A5.4.] [Structural steel doors shall be of welded construction.] In order to reduce distortion and residual stresses, a welding sequence shall be used. All welds shall be stress relieved, and welded doors and frames shall be post-weld straightened. Fabricated steel shall be well-formed to shape and size, with sharp lines and angles. Intermediate and corner joints shall be coped or mitered. Exposed welds shall be dressed smooth. [The stiles [and top] of built-up structural steel doors shall be closed using channel shapes or plates.] [When feasible, faceplates for structural steel doors shall be one piece. When one-piece faceplates are not feasible, plates shall be joined using full penetration groove weld butt joints or other approved welds.] [Reinforced concrete doors shall be closed at the edges with structural steel channels or plates and latch housings shall be mortised. Lap splices shall not be used for flexural reinforcing bars.] [Spall plates shall be one piece, covering the entire concrete surface on the seating face of the door, and shall be securely welded to the door edges. Spall plates shall not be less than 1/4 inch thick.] [Faceplated reinforced concrete doors shall be provided with one-piece faceplates on both door faces. Faceplates shall cover the entire concrete surface and shall be securely welded at the door edges. Faceplates shall be not less than 3/8 inch thick.] [Hollow metal door frames shall be pressed steel or structural steel with welded joints. Steel frames or subframes installed in masonry walls shall be provided with adjustable anchors. Hollow metal doors shall be of unitized grid construction with welded grid junctions and shall have flat, one-piece face sheets spot welded to the grid system. The edges of hollow metal doors shall be closed with seams continuously welded. Hollow metal doors shall be neat in appearance, free from warpage and buckle, and suitable reinforcing shall be provided for hardware.]

#### 2.4.2 Mullion

Mullions for double doors shall be fabricated in the same manner specified for frames. [Fixed mullions shall be welded to the frame.] [Removable mullions shall be attached to the frame with mechanical fasteners that are accessible for mullion removal or, in lieu of the removable mullion, an astragal shall be provided at the seating face of the inactive door leaf.]

Doors shall seat directly against the mullion, and the mullion or astragal shall be capable of transferring the door reactions to the frame.

#### 2.4.3 Thermal Insulation

The interior cells between the unitized grid shall be completely filled with thermal insulation material. The U value through the door (panel) shall not exceed [0.24] [\_\_\_\_\_].

#### 2.4.4 Shop Finishing

[Shop priming of steel surfaces shall conform to Section 09900PAINTING, GENERAL except that surfaces that will be embedded in concrete need not be primed and hollow metal doors shall be either dipped in primer after welding is completed, or exposed surfaces shall be primed and interior surfaces coated with an approved rust inhibitor]. [Galvanizing of doors and frames shall conform to ASTM A 123 or other approved methods. Surfaces that will be embedded in concrete need not be galvanized and the interior of hollow metal doors may be treated with an approved rust inhibitor in lieu of galvanizing. Galvanizing of exposed portions of concrete anchors, nonstainless steel fasteners, and hardware other than factory finished hardware shall conform to ASTM A 153 or other approved methods.]

#### 2.4.5 Clearance

[The clearance between the seated steel surfaces of structural steel doors and frames shall not exceed 1/16 inch.] [The lateral clearance between flush mounted structural steel doors and frames shall not exceed [1/4] [\_\_\_\_\_] inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed [1/2] [\_\_\_\_\_] inch.] [The lateral clearance between hollow metal doors and frames shall not exceed 1/8 inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed 1/4 inch.] The clearance between the door bottom and threshold shall not exceed 3/4 inch.

### 2.5 BLAST DOOR ASSEMBLIES

#### 2.5.1 Door [\_\_\_\_\_]; Steel

##### 2.5.1.1 Type

Type shall be [structural steel] [double structural steel door with [fixed] [or] [removable] mullion] [,] [galvanized] [,] [and] [fire-rated].

##### 2.5.1.2 Overpressure

Overpressure shall be [\_\_\_\_\_] psi [with a [\_\_\_\_\_] millisecond duration] in the [seating] [unseating] direction [and [\_\_\_\_\_] psi [with a [\_\_\_\_\_] millisecond duration] in the unseating direction]. The [shock and gas overpressure] [overpressure] waveform shall be as indicated.

##### 2.5.1.3 Fragment

[The fragment shall be [\_\_\_\_\_] ounces with a velocity of [\_\_\_\_\_] fps and impact [normal to][at an angle of [\_\_\_\_\_] degrees measured from] the door face.] [Protection from fragments shall be provided by steel plate not less than [\_\_\_\_\_] inches in thickness.]

##### 2.5.1.4 Rebound

Rebound resistance shall be [50] [100] [\_\_\_\_\_] percent.

##### 2.5.1.5 Deformation Limits

The ductility ratio shall not exceed [10] and the support rotation shall not

exceed 2 degrees] [20 and the support rotation shall not exceed 12 degrees].

#### 2.5.1.6 Hardware

Full surface hinges shall be Type [1] [2] [3]. [Multiple] [Jamb] latching points and [multiple lever handles] [,] [or] [a single lever handle] [,] [or] [a wheel handle] [,] [or] [a spoke lever handle] operated from [the seating face] [and] [opposite the seating face] with [manual] [self-latching] latch engagement and [either] sliding [or lever] latch bolts shall be provided. The latching mechanism shall be [safety] [or] [cover] plated. A [Type [I] [II] [III] straight steel bar door pull] [,] [and] [padlock] [shrouded padlock] [,] [and] [hasp] [high security hasp] [shrouded hasp] [,] [and] [door stop] [,] [and] [surface door closer] [overhead door holder] [,] [and] [gasket seals] [door silencer] [,] [and] [optical device] shall be provided.

#### 2.5.1.7 Operating Forces

[Maximum operating forces shall be [30] [40] [\_\_\_\_\_] pounds to set the door in motion and [20] [\_\_\_\_\_] pounds to swing the door. Maximum force to engage and release latches shall be [20] [30] [40] [\_\_\_\_\_] pounds.] [Operating forces shall conform to NFPA 101.]

#### 2.5.1.8 Accessories

A [removable threshold] [or] [ramp] [and] [self-rescue kit] shall be provided.

#### 2.5.2 Door [\_\_\_\_\_] ; Concrete

##### 2.5.2.1 Type

Type shall be [reinforced concrete] [double reinforced concrete] door with [fixed] [or] [removable] [mullion] [and] [with] [spall plate] [faceplates].

##### 2.5.2.2 Overpressure

Overpressure shall be [\_\_\_\_\_] psi [with a [\_\_\_\_\_] millisecond duration] in the [seating] [unseating] direction [and [\_\_\_\_\_] psi with a [\_\_\_\_\_] millisecond duration in the unseating direction]. The [shock and gas overpressure] [overpressure] waveform shall be as indicated.

##### 2.5.2.3 Fragment

[The fragment shall be [\_\_\_\_\_] ounces with a velocity of [\_\_\_\_\_] fps and impact [normal to][at an angle of [\_\_\_\_\_] degrees measured from] the door face.] [The nominal door thickness shall not be less than [4] [8] [\_\_\_\_\_] inches.]

##### 2.5.2.4 Rebound

Rebound resistance shall be [20] [100] [\_\_\_\_\_] percent.

##### 2.5.2.5 Deformation Limits

[The door support rotation shall not exceed [1 degree] [2 degrees] for one-way acting doors without stirrups, [2] [4] degrees for one-way acting doors with stirrups, and [2] [8] degrees for two-way acting doors.] [The support rotation shall not exceed 2 degrees except that the support rotation for one-way acting doors without stirrups shall not exceed 1 degree.]

##### 2.5.2.6 Hardware

Hinges shall be Type 2. [Multiple] [Jamb] latching points and multiple

lever handles operated from [the seating face] [and] [opposite the seating face] with manual latch engagement and lever latch bolts shall be provided.

Type [I] [II] [III] straight steel bar door pull [,] [and] [padlock] [shrouded padlock] [,] [and] [hasp] [high security hasp] [shrouded hasp] [,] [and] [door stop] [,] gasket seals [, and optical device] shall be provided.

#### 2.5.2.7 Operating Forces

Maximum operating forces shall be [40] [\_\_\_\_\_] pounds to set the door in motion and [20] [\_\_\_\_\_] pounds to swing the door. Maximum force to engage and release latches shall be [30] [\_\_\_\_\_] pounds.

#### 2.5.2.8 Accessories

A [removable threshold] [ramp] [and] [self-rescue kit] shall be provided.

#### 2.5.3 Door [\_\_\_\_\_] ; Metal

##### 2.5.3.1 Type

Type shall be [hollow metal] [double hollow metal door with a [fixed] [or] [removable] mullion] [,] [galvanized] [ ;] [and] [thermal insulation] [sound-rated to STC [40] [\_\_\_\_\_] ] [, and] [fire-rated].

##### 2.5.3.2 Overpressure

Overpressure shall be [\_\_\_\_\_] psi in the [seating] [unseating] direction [and [\_\_\_\_\_] psi in the unseating direction].

##### 2.5.3.3 Rebound

Rebound resistance shall be [50] [100] [\_\_\_\_\_] percent.

##### 2.5.3.4 Hardware

[Full surface] [Mortise] hinges shall be Type [1] [2] [3]. [[Multiple] [Jamb] latch points and [multiple lever handles] [or] [a single lever handle] operated from the [seating face] [and] [opposite the seating face] with [manual] [self-latching] latch engagement and [either] sliding [or] lever] latch bolts shall be provided.] [Exit device with [multiple latch points] [jamb latch points] [and with function [\_\_\_\_\_] ] shall be provided.] [Mortise lock and latch set [with function [\_\_\_\_\_] ] shall be provided.] [A [padlock] [and] [hasp] [,] [and] [door stop] [,] [and] [surface door closer] [overhead door holder] [,] [and] [gasket seals] [door silencer] [,] [and] [optical device] shall be provided.]

##### 2.5.3.5 Operating Forces

[Maximum operating forces shall be [20] [\_\_\_\_\_] pounds to set the door in motion and [15] [\_\_\_\_\_] pounds to swing the door.] [Operating forces shall conform to NFPA 101.] Maximum force shall be [20] [\_\_\_\_\_] pounds to engage and release latches.

##### 2.5.3.6 Accessories

A [removable threshold] [or] [ramp] shall be provided.

#### 2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

##### 2.6.1 Prototype Static Test

Static tests on prototype door assemblies shall demonstrate that the door will resist the blast overpressure. Static tests will be accepted only if the door and frame proposed are manufactured using the same materials,

dimensions, and tolerances as those in the prototype static test and the static overpressure used in the test is at least two times the blast overpressure. Static test reports shall be supplemented with calculations that demonstrate rebound resistance when rebound is not tested.

#### 2.6.2 Prototype Blast Test

Blast tests on the prototype door assembly shall demonstrate that the door will resist the overpressure waveform. Blast tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype blast tests. The rise time of the test waveform shall be zero or subject to approval. [For an overpressure with infinite duration, the overpressure used in the test shall be not less than that specified or indicated for a duration equal to at least five times the natural period of the door and the test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance.] [For overpressure with finite duration, the overpressure waveform used in the test shall exceed the overpressure waveform in both peak overpressure and impulse and the blast test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance when the positive phase waveform duration in the test exceeds the positive phase duration specified or indicated.]

#### 2.6.3 Shop Operating Test

Prior to shipment, each door assembly shall be fully erected in a supporting structure and tested for proper operation. Such testing shall include opening, closing, and operating all moving parts to ensure smooth operation and proper clearance, fit, and seating. The operating forces and opening and closing times shall be determined. The Contracting Officer shall be notified at least [7] [\_\_\_\_\_] calendar days prior to the start of testing and [all doors] [door [\_\_\_\_\_] [,] [\_\_\_\_\_] [,] [and] [\_\_\_\_\_] ] shall be tested in the presence of the Contracting Officer. A test report shall be prepared and [three] [\_\_\_\_\_] copies furnished within [7] [\_\_\_\_\_] calendar days after testing.

#### 2.6.4 Air Leakage Test

Each door assembly for which [door seals] [or] [thermal insulation] [are] [is] specified shall be factory tested for air leakage rate in accordance with ASTM E 283. The rate of air leakage per unit length of crack shall not exceed [0.20] [\_\_\_\_\_] cfm using a pressure difference of [1.57] [\_\_\_\_\_] psf. Prototype tests can be substituted for door assembly tests when the prototype door, frame, and hardware tested are equivalent to that provided or when otherwise approved.

#### 2.6.5 Sound Rating Test

The sound transmission class (STC) rating shall be determined in accordance with ASTM E 90.

#### 2.6.6 Fire Rating Test and Inspection

Fire-rated door assemblies shall bear the listing identification label of the UL, or other nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. Doors exceeding the size for which listing label service is offered shall be inspected in accordance with NFPA 80, NFPA 80A, and NFPA 101.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors and frames shall be installed in accordance with the manufacturer's

written instructions. [Concrete shall be placed in reinforced concrete doors using the door manufacturer's standard forms.] [Pressed steel frames for hollow metal doors shall be fully grouted.] Exposed surfaces shall be finish painted in accordance with Section 09900 PAINTING, GENERAL. Galvanized surfaces damaged prior to final acceptance shall be repaired in accordance with ASTM A 780 to the same thickness as the original galvanizing.

### 3.2 TESTS

After installation is completed, each door shall be field tested for operation, clearance, fit, and seating by operating the door and hardware through at least 10 operating cycles. Door and hardware operation shall be tested using the forces specified. Personnel and equipment required to perform field testing shall be provided by the Contractor. Unless waived, all field tests shall be performed in the presence of the Contracting Officer. After testing is completed, test reports shall be prepared and [three] [\_\_\_\_\_] copies furnished.

### 3.3 MANUFACTURER'S FIELD SERVICE

Installation and testing of door assemblies shall be under the supervision of the door manufacturer's erection engineer. Upon completion of the work, and at a time designated by the Contracting Officer, the services of one engineer and other technical personnel as required shall be provided for a period of not less than [4] [\_\_\_\_\_] hours to instruct Government personnel in the operation and maintenance of the blast doors and all other items furnished under this specification section. The instructions shall also include use of the operation and maintenance manual. The instructions shall include videotapes. An instruction outline and procedure shall be submitted and approved prior to scheduling the instruction. One copy of all instruction material shall be provided at the time of instruction.

-- End of Section --

## SECTION 15010

## BASIC MECHANICAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Basic Mechanical requirements that are applicable to all Division 15 sections in addition to Division 0 - Contract Requirements and Division 1 - General Requirements.
- B. Mechanical work covered by all sections within DIVISION 15 - MECHANICAL of these Specifications, including but not limited to:
  - 1. Heating, ventilating, air conditioning and refrigeration systems and equipment.
  - 2. Plumbing systems and equipment.
  - 3. Fire protection systems and equipment.
  - 4. Controls systems

## 1.2 RELATED SECTIONS

- A. Division 0 - Contract Requirements
- B. Division 1 - General Requirements
- C. Division 3 - Concrete
- D. Division 9 - Finishes
- E. Division 11 - Equipment
- F. Division 12 - Furnishings
- G. Division 13 - Special Construction
- H. Division 14 - Conveying Systems
- I. Division 16 - Electrical
- J. Divisions 1 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS: These shall apply to all work included in this section. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this and the other sections of Division 15.
- K. This section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
  - 1. Reference Standards, Codes and Fees
  - 2. Quality Assurance
  - 3. Submittals
  - 4. Maintenance Manuals
  - 5. Job Conditions

6. Accuracy of Data and Drawings
7. Electrical Requirements for Mechanical Equipment
8. Coordination Drawings
9. Record Documents
10. Identification
11. Fire-Stop Materials
12. Rough-ins
13. Field Tests
14. Excavation and Backfill
15. Adjusting and Cleaning
16. Installation
17. Removal and Relocation of Existing Work
18. Painting

#### 1.3 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall obtain and pay for all licenses and permits required to perform work covered by DIVISION 15 - MECHANICAL, and obtain and pay for all necessary inspections by all applicable authorities.

#### 1.4 CODES AND STANDARDS

Select related codes or standards.

- A. In addition to requirements of Divisions 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS, all work shall be manufactured, installed and labeled in accordance with the applicable provisions of the latest editions of the following codes and standards, including addenda and modifications made by local authorities.

1. Local Codes
2. State Codes
3. Federal Codes
4. ASME Boiler Code
5. AGA - American Gas Association
6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
7. AABC - Associated Air Balance Council
8. NEMA - National Electrical Manufacturer's Association
9. ANSI - American Society National Standards Institute
10. ASME - American Society of Mechanical Engineers
11. NFPA - National Fire Protection Association

12. ARI - Air-Conditioning and Refrigeration Institute
13. UL - Underwriters Laboratories, Inc.
14. BOCA National Codes - Building, Mechanical, Plumbing, Fire Prevention, Existing Structures, Sewage Disposal, Energy, Etc.
15. SBCCI Standard Codes - Building, Mechanical, Plumbing, Fire Prevention, Energy Conservation Etc.
16. Uniform Codes - Building, Mechanical, Plumbing, Fire Prevention, Etc.
17. National Codes - Building Mechanical, Plumbing, Fire Prevention, Etc.
18. ASPE - American Society of Plumbing Engineers.
19. OSHA - Occupational Safety and Health Act.
20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc. 1985 HVAC Duct Construction Standards.

#### 1.5 QUALITY ASSURANCE

- A. The use of manufacturer's names and catalog numbers in these specifications or on the drawings indicates the type, size, rating, capacity, design, quality, or kind of materials required and a closed specification is not intended, and similar and equal products of any reputable manufacturer which will satisfactorily perform the required functions will be acceptable, unless otherwise indicated by the words NO SUBSTITUTES, or unless otherwise specifically stated. The Architect/Engineer reserves the right to reject all materials which he deems not equal to those specified, or which he decides will not satisfactorily perform the required functions.
- B. Supply all equipment and accessories new and free from defects.
- C. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- D. Supply all equipment and accessories in compliance with the applicable standards listed in Article 1.4 of this section and with all applicable national, state, and local codes.
- E. When included, reflected ceiling plan drawings shall govern over mechanical and electrical drawings for location of ceiling-mounted elements.
- F. In addition to all requirements specified hereinafter, each material and equipment item shall have all features as standard with its manufacturer and/or required for the complete operational system.
- G. Capacities, ratings, sizes and other requirements not specified hereinafter shall be as scheduled or otherwise indicated on the drawings.
- H. Should the Trade Contractor at any time discover a discrepancy between engineering and architectural drawings or with respect to a variance of code requirements, he shall notify the Architect/Engineer for clarification and shall

not proceed with the work affected until clarification has been made.

#### 1.6 SUBMITTALS

- A. Submittals and shop drawings shall be submitted in accordance with Divisions 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS and in accordance with the following.
1. Carefully review the requirements of DIVISIONS 0 and 1.
  2. All equipment, material, and manufacturer's literature shall be submitted for approval at one time and in a tabulated high quality 3 ring binder. Control drawings and the controls equipment submittal may be submitted at a later time, but as soon as practical after the contract has been awarded and after the general equipment submittal has been made. However, every attempt shall be made to include the complete controls submittal with the general equipment submitted at one time.
  3. The submittal shall include summary cover sheet(s) and manufacturer's literature under each tab of the submittal binder which together clearly indicate compliance or deviation from the specifications and drawings. Each submittal brochure shall be signed, on the index page, by Contractor. This signature shall indicate the Contractor has examined all data therein and found same to be in order.
  4. Submission material and all shop drawings shall be marked up with the appropriate identification relating the equipment to the drawings. Mark and reference each item on the submittal summary sheet and the manufacturer's literature to the appropriate paragraph number in the specifications. Manufacturer's standard catalogs will not be accepted.
  5. Failure to comply with the above for a complete and clear submittal will result in resubmittal.
  6. A minimum of (7) copies of all submittals shall be provided of which (3) will be returned to the Owner by the Contractor, (2) will be retained by the A/E, and (2) will be available for Contractor's use.
- B. Maintenance Manuals:
1. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for each equipment item. Behind a separate tab for each piece of equipment, provide the following:
    - a. A copy of the equipment submittals and shop drawings as provided in (A) above.
    - b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
    - c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and

- normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions, as applicable.
  - d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - e. Servicing instructions and lubrication charts and schedules.
- 2. Before requesting acceptance of work, furnish the number of printed and bound sets required in DIVISIONS 0 and 1.
  - 3. Detailed and simplified one line, color coded flow and wiring diagrams.
  - 4. Schedule of valve identification.
  - 5. Provide seven copies of all manuals.
- C. Field test report: required by Section 15990 - BALANCING AND TESTING BY INDEPENDENT AGENCY. Provide seven copies.

#### 1.7 JOB CONDITIONS

- A. Examine related work and surfaces before starting work of any section.
  - 1. Report to Architect/Engineer, in writing, conditions which will prevent proper provision of this work.
  - 2. Installed work which interferes with architectural or any other work, or which deviates from drawings and specifications without Architect's prior approval, shall be altered by DIVISION 15 - MECHANICAL, without cost to the Owner, to clear such interferences, or to comply with the drawings and specifications. Interferences or discrepancies which may be discovered or anticipated shall be reported promptly to Architect for his decision before proceeding with the work involved. Architect shall have privilege of making minor changes without additional cost, provided that such changes are made before commencing work on items involved.

#### 1.8 ACCURACY OF DATA AND DRAWINGS

- A. Drawings are generally diagrammatic, and where not dimensioned or detailed, indicate approximate locations of work. Examine carefully existing buildings and structures, existing systems, and all other contract drawings, and install work to conform as nearly as possible to locations and arrangements indicated, with only such minor adjustments as necessary to coordinate work with architectural and other work, and to avoid interferences therewith. All piping and ductwork, offsets, risers, and fittings are not necessarily shown; however, provide these as required by the conditions involved.
- B. Building and structure dimensions: TAKE THESE FROM ARCHITECTURAL AND STRUCTURAL DRAWINGS, AND FROM ACTUAL MEASUREMENTS MADE EACH BUILDING INVOLVED.

#### 1.9 ELECTRICAL CHARACTERISTICS, MOTOR SIZES, MOTOR STARTERS, CONTROLS, AND WIRING

- A. DIVISIONS 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS: These shall apply to the work related in this section.
- B. Motor starters and other electrical control devices: Generally, motor starters for equipment motors shall be furnished by DIVISION 16 - ELECTRICAL; however, this section shall furnish ONLY those motor starters which may be specified hereinafter in this Section. Also, this section shall furnish and install all other electrical control devices required for the Mechanical system, unless otherwise specified.
- C. Installation of electrical devices, EXCEPT those factory mounted on equipment: electrical control devices which require electrical connections ONLY, shall be installed by DIVISION 16 - ELECTRICAL. All control devices which are not factory mounted on the equipment and require piping, linkage, remote bulb, or other mechanical connections as well as electrical connections shall be installed by the Section that furnished the equipment involved, ready for electrical connection.
  - 1. Electric wiring: Division 15 shall perform any and all control and interlock wiring necessary for the operation sequence described in Section [15950] [15951] or on mechanical plans with properly licensed personnel. Any wiring requirements for control devices furnished under Division 15 shall be provided by Division 15. Wiring for control devices not furnished by Division 15 or devices that are factory mounted on mechanical equipment requiring electrical connections only shall be by Division 16. Division 16 shall provide dedicated 120 VAC, 15-20 amp power to designated control panel locations. Exact locations shall be coordinated between Division 15 and 16.
  - 2. All necessary interlocking contacts and remote starting contacts and remote starting devices not installed on local control panels shall be supplied with the starters and it shall be the responsibility of Division 15 to coordinate the number of contacts required. If individual control transformers are required, provide the transformers necessary for the additional power required by auxiliary control devices. This coordination shall occur prior to ordering starters and the cost shall be included in the bid proposal.
  - 3. Control wiring materials and installation shall conform to Division 16 requirements.

#### 1.10 PROJECT RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT RECORD DOCUMENTS." In addition to the requirements specified in Division 1, indicate the following installed conditions:
  - 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
  - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located

(i.e., traps, strainers, expansion compensators, tanks, etc.) Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
5. Contract Modifications, actual equipment and materials installed.
6. These documents shall be prepared in Microstation format and provided with project closeout documentation in disk and hard copy format.

## PART 2 - PRODUCTS

### 2.1 HOUSEKEEPING PADS

- A. Provide 4" concrete pads for all floor mounted mechanical equipment such as circulating pumps, chillers, air handling units, etc. Pad dimensions shall be approximately 2" inches larger than the equipment in the width and depth dimensions. Bevel the edges of the pad to reduce chipping. Refer to section 03300 for concrete specifications.

## PART 3 - EXECUTION

### 3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

### 3.2 FIELD TESTS

- A. All piping shall be free of leaks, and test gauges shall show no loss of pressure for at least 30 minutes, after source of test pressure has been cut off, or as noted. Pipes may be tested in sections as the work progresses. Repair and retest all sections failing to pass tests, as required to obtain approval of tests. No caulking, welding or brazing will be permitted on threaded pipe or fittings to stop leaks. Replace with new material all cracked or otherwise defective pipe and fittings of all types, as approved. Furnish suitable testing equipment, give the Architect/Engineer and all applicable authorities ample advance notice of all proposed tests and readiness of work for inspections, and conduct each test in their presence, as approved. Do not conceal or insulate piping and do not conceal ductwork until all inspections have been made and all required tests have been approved by the Architect/Engineer and all applicable authorities. Submit results for review.
- B. Provide required labor, material, equipment and connections.
- C. Test all piping, EXCEPT as otherwise specified below, as follows: hydrostatic test, at 150 percent of normal operating pressure of piping involved, or 100 psi (690 kpa),

whichever is higher, AFTER removing all air from piping involved in test.

1. Natural gas and fuel oil piping: 50 psi (345 kpa) test using air or inert gas.
  2. Soil, waste, vent roof drainage, and acid waste piping: standard water test, by filling piping with water up to top of vent stack or highest point of piping test section involved, but no section tested with less than a ten foot head with no pressure loss for at least 30 minutes.
  3. Compressed air: air test at 150 percent of normal working pressure of piping involved, or 100 psi (690 kpa), whichever is higher.
  4. Fire protection piping: 200 psi (1380 kpa) two hour duration hydrostatic test, AFTER removing all air from piping involved in test, with pressure gauged at bottoms of standpipes. Conduct this test in presence of authorized representative of the Fire Department having jurisdiction.
  5. Chilled water and heating water piping: Water test at 150% of normal working pressure of piping involved, or 100 psig (690 kpa), whichever is higher.
  6. Test all equipment in accordance with sections specified hereinafter.
- D. Test all ductwork constructed to 2" (500 pa) W.G. class or higher, in accordance with leakage test method recommended in 1985 SMACNA "Duct Construction Standards". After remedying audible leaks, total leakage on system shall not exceed one percent of system total design air flow rate.

### 3.3 EXCAVATION AND BACKFILL

#### A. Excavation, Underground Pipework:

1. Cut trenches to indicated and/or required lines, and to depths which will:
  - a. Provide full length bearing of pipe barrels on firm ground.
  - b. Provide 24 inch (610 mm) MINIMUM earth cover over all pipes outside of buildings and structures.
2. Piping shall be laid on a six inch (152 mm) bed of sand and backfilled with 12 inches (305 mm) of sand in six inch (152 mm) layers.
3. Seat pipe on sand fill as required to facilitate jointing, and to prevent pipe hubs, couplings and valves from bearing on sand before backfilling.
4. Sheet and brace excavations as required to prevent cave-ins and protect personnel and adjacent structures.
5. Where pipelines are below footings, horizontal distance between footings and pipelines shall be as required to provide not steeper than a 1:1 slope from footing bottoms to trench bottoms at all points.

- B. Backfill, Trenches
1. After each pipeline has been laid, tested and approved, thoroughly hand tamp backfill into bell holes, around pipe, and up to six inches (152 mm) above pipe top.
  2. Place remaining backfill in 8 inches (203 mm) maximum thickness loose layers, and with pneumatic or other suitable power tampers compact each layer to the backfill density specified in SITEWORK.
  3. Backfill materials shall be of the following types:
    - a. Up to six inches (152 mm) above pipe tops: sand, ONLY.
    - b. From six inches (152 mm) above pipe tops up to finished grade or subgrade, as required.
      - (1) Any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following material which are larger than six inches in their greatest dimensions: rock, stone, concrete, asphalt paving, or masonry.
      - (2) Dispose of excavated materials which are not replaced as backfill, as approved.
- C. Excavation and Backfill for Structures Related to Mechanical Work
1. This shall conform to applicable requirements in Division 2 - SITEWORK.
- D. Unsuitable Subsurface Conditions
1. Where excavation bottoms at required elevations are found to be unstable, or where rock, cinders, rubbish, or other deleterious materials are encountered, extend excavations down to firm earth, but at least 6 inches (152 mm) below deleterious materials.
  2. Bring excavation bottoms back up to required pipe laying subgrade by backfilling with suitable material, thoroughly compacted in place as specified above.
  3. "Suitable material" shall be as specified above.
  4. Dispose of excavated unsuitable subgrade materials, as approved.
- E. Warning Tape for Buried Pipeline: Install detectable warning tape directly over every pipeline by burying tape as close to the surface as possible, but no less than 6 inches (152 mm) beneath finished grade.

### 3.4 ADJUSTING AND CLEANING

- A. Flush or blow all welding slag, pipe joint compound, loose scale, and other debris from pipework before connecting equipment thereto.
- B. After systems have been tested and before any field painting is commenced, clean up all work thoroughly. Remove all foreign matter which has accumulated in ducts, casings, enclosures, fixtures, and equipment. Clean and polish all valves, plates, and other surfaces that are not to be

painted, so that they present a new and acceptable appearance.

- C. Put systems in operation, test all fixtures and other equipment, remedy all leaks and defects, make all necessary adjustments, and remove all air from water circulating systems. Adjust all air and water flows to indicated and/or required quantities, and adjust all controls and other items as required to balance system and provide uniform air flows and uniform temperatures in air conditioned areas. Demonstrate that all controls and mechanical equipment function satisfactorily, as specified, as indicated, and as approved.
- D. Sterilization of Domestic Water System: AFTER all water connections have been made to all fixtures and equipment, and BEFORE plumbing system is used by Owner, sterilize entire potable water system as specified below, and submit a written report certifying that this has been done in accordance with the requirements of the State Department of Public Health.
  - 1. Drain entire water system.
  - 2. Refill entire water system with a sterilizing solution of potable water containing at least 50 parts per million of available chlorine.
  - 3. Allow sterilizing solution to remain in water system for at least 24 hours, then drain all sterilizing solution from water system.
  - 4. With potable water, flush all traces of sterilizing solution from entire water system through each fixture and each water outlet.
- E. Strainers and Dirt Pockets: Clean out each of these; REMOVE EACH STRAINER SCREEN FOR CLEANING. Initially install very fine mesh screen for system cleaning and operate System to a minimum of 24 hours. Remove screen, clean it and replace it in system until a clean system is verified. Remove screen and replace with screen at mesh for normal operation.
- F. Circulating Water Systems: Completely drain each of these, and refill with clean water.
- G. Compressed air and medical gas piping shall be cleaned in accordance with the requirements of Section 15400 - COMPRESSED AIR SYSTEM.
- H. After systems have been tested and before putting any part of or the entire system in operation for Owner's beneficial use, insure that all necessary adjustments have been made.
  - 1. Bearings and other items requiring lubrication, except factory permanently lubricated type: lubricate each of these as recommended by its manufacturer; this includes lubricated type plug valves.
  - 2. Belts: adjust each of these to proper tension.
  - 3. Filters: replace each disposable ("throw away") filter with a new clean filter (except blanket roll and high efficiency type). Clean each cleanable filter. NOTE: ALL FILTERS SHALL BE IN PLACE DURING TESTING AND ADJUSTING AND SHALL BE CLEAN.

4. Motor load tests: make an ammeter check of actual running current of each motor in mechanical system under operating conditions. Correct all motors which are found to be overloaded, as approved.

### 3.5 INSTALLATION

- A. General: Sequence, coordinate and integrate the various elements of mechanical systems, materials, and equipment.
- B. Equipment rooms and other areas in which equipment is to be installed have limiting dimensions. Coordinate mechanical systems, equipment, and materials installation with other building components. Install all mechanical work within these areas substantially as indicated, with ample unobstructed access space around each piece of equipment to facilitate proper installation, operation, and maintenance of equipment, and to allow ample space for plumbing, electrical, and other equipment indicated to be installed therein. Minor revisions in layout may be made subject to Architect's approval, but major changes in layout to accommodate proposed equipment which differs substantially from specified equipment in size and arrangement will not be considered. Each bidder shall determine before bidding that equipment upon which he proposes to base his bid will conform to these requirements. Install each equipment item in accordance with its manufacturer's recommendations, and as indicated on the drawings, and/or specified. If the drawings and/or specifications conflict with the manufacturer's recommendations, report this to the Architect/Engineer for his decision before proceeding with the work involved.
- C. Equipment NOT furnished by mechanical section but requiring mechanical connections from other Sections and others furnishing this equipment, determine exact mechanical connection requirements therefor; locations and arrangements of connections indicated for this equipment are APPROXIMATE ONLY.
- D. Arrange for chases, slots and openings in other building components during progress of construction, to allow for mechanical installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- F. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- G. Where installation heights are not detailed or dimensioned, and equipment requires periodic service, verify height with Owner and/or Architect prior to installation, otherwise install to provide the maximum headroom possible.
- H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
- I. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for

ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

- J. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Generally, install pipework and ductwork as follows unless otherwise indicated.
  - 1. Finished areas: conceal pipework and ductwork within pipe chases, above suspended ceiling and within other building construction, in offices, rest rooms, and other finished areas, unless otherwise indicated.
  - 2. Unfinished areas: install above ground pipework and ductwork exposed in areas where pipe chases or suspended ceilings are not indicated or concealing is otherwise impracticable, in mechanical and electrical equipment rooms or storage areas, and other unfinished areas.
  - 3. ALL areas: install pipework and ductwork parallel or at right angles with beams, walls, ceilings, and other building lines, in straight lines between required direction changes, with vertical runs plumb. Install exposed pipework and ductwork as close as practicable to walls, columns, ceilings, and overhead construction, and to provide maximum headroom and minimum interference with usable building space.

### 3.6 PAINTING

- A. All surfaces shall be left clean and free from oil.
- B. All equipment shall be factory prime coated and painted; however, the following may be shop prime coated and made ready for painting:
  - 1. Tanks.
  - 2. Structural supports and frames.
- C. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.
- D. Uncoated Hangers, Supports, Rods, and inserts shall be prime coated.
- E. Exposed, uninsulated black steel piping, pipe supports, and pipe braces shall be prime coated.
- F. All ductwork, conduit, insulation, pipe, and structures visible through grilles and diffusers shall be painted flat black.
- G. Marred surfaces of prime coated or factory painted surfaces shall be painted and/or primed to match adjacent coat.
- H. Provide enamel paint where specified.
- I. Refer to Section 09900 for Painting.

### 3.7 IDENTIFICATION OF VALVING AND EQUIPMENT

- A. Identify valves, (including main pipe sectionalizing valves and branch valves) except those on or within hand reach of

equipment controlled thereby with a minimum 1-1/2 inch (38 mm) diameter round brass or aluminum tag stamped with 1/4 inch (6 mm) (minimum) height letters designating material controlled by valve, and attached to valve body with 18 (minimum) gauge (1.3 mm) solid copper or galvanized steel wire. Submit a typed valve identification schedule with the operating instructions and parts list submittal described above under article 1.12 SUBMITTALS AND SHOP DRAWINGS.

- B. Equipment: Label each major mechanical equipment item (such as AHU, pump, fan, condensing unit, boiler, water heaters, etc.) with nameplate engraved with equipment designation and number, and securely attached to equipment.

### 3.8 IDENTIFICATION OF PIPING

- A. Identify piping with self-sticking vinyl cloth pipe markers and pipe marker arrows, each sized as recommended by marker manufacturer for outside diameter of pipe (including pipe insulation) labeled therewith. Marker background colors shall conform to OSHA, NFPA and ANSI pipe identification standards as scheduled in Table (I). Each pipe marker shall be lettered to indicate the material contained in the pipeline involved and arrows shall indicate direction of material flow in the pipelines.
- B. Provide a full color piping Identification Schedule indicating material type within pipe and its corresponding color coding.
- C. Locate Identification As Follows:
  - 1. Mechanical Equipment Rooms:
    - a. Within 1'-6" (0.46m) of each valve or valve assembly.
    - b. Within 3'-0" (0.92m) of each 90 deg (1.57 Rad) elbow, connection to equipment or vessel, point where pipe enters shafts and pierces outside walls.
    - c. On not over 20'-0" (6.1 m) intervals along all exposed piping.
  - 2. Above Suspended Ceilings:
    - a. Within 1'-6" (0.46 m) of each valve or valve assembly.
    - b. At tees within 3'-0" (0.92 m) of both main and branch.
    - c. Within 3'-0" (0.92 m) of each 90 deg (1.57 Rad) elbow.
  - 3. Piping Concealed in Chases or Shafts:
    - a. Each pipe visible through an access door or panel.
  - 4. Piping Exposed in Rooms Other than Mechanical Equipment Areas:
    - a. Omit identification of piping, 1/2" (13 mm) and smaller, exposed at connections to equipment or plumbing fixtures.
    - b. With the above exception, identify at not less than (1) point each piping run visible in each room with identification on not over 20'-0" (6.1 m) intervals.

D. Refer to Section 15190 for Mechanical Identification.

TABLE I  
SCHEDULE OF PIPING IDENTIFICATION

<u>CLASSIFICATION</u>	<u>BACKGROUND COLOR</u>	<u>LETTERING</u>
(Per ANSI A13.1)		
Domestic Cold Water	Green	White
Domestic Hotwater Supply	Green	White
Domestic Hotwater Return	Green	White
Equipment Drains, Roof Drains	Green	White
Sanitary Drains, Storm Drains	Green	White
Fire Protection Water	Red	White
Plumbing Vent Lines	Green	White
Compressed Air	Blue	White

3.9 FIRE-STOP MATERIALS

A. Seal around all pipes, ducts, and conduit penetrating fire-rated partitions, in accordance with manufacturer's instructions. Caulk and putty shall be applied to the proper depth for the fire rating required, as listed in the manufacturer's instructions.

END OF SECTION

## SECTION 15080

## THERMAL INSULATION FOR MECHANICAL SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1995a) Stainless and Steel Wire
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1992) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 871	(1995) Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

ASTM C 916	(1985; Rev 1996) Adhesives for Duct Thermal Insulation
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 921	(1989 R; 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C 1126	(1996) Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM D 3278	(1996) Test Methods for Flash Point of Liquids by Small Scale & Closed-Cup Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
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MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA-01	(1993) National Commercial & Industrial Insulation Standards
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## 1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

## 1.3 GENERAL QUALITY CONTROL

### 1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

### 1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Jackets shall comply with the flame

spread and smoke developed ratings of 25/50 as determined by ASTM E 84.

#### 1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-14 Samples

Thermal Insulation Materials; FIO.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

After approval of materials and prior to applying insulation a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA-01 plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment required to be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application.

The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label which identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

#### 1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

### PART 2 PRODUCTS

#### 2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet

ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

#### 2.1.1 Adhesives

##### 2.1.1.1 Acoustical Lining Insulation Adhesive

Insulation shall be applied in cut-to-size pieces attached to the interior of the duct with a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire-resistant adhesive to prevent delamination of glass fibers.

##### 2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

##### 2.1.1.3 Lagging Adhesive

Lagging adhesives shall be nonflammable and fire-resistant and shall have flame spread and smoke developed ratings of 25/50 when measured in accordance with ASTM E 84. Adhesives shall be either the Class 1 or Class 2 type as defined below. Class 1 adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation. Class 2 adhesive shall be pigmented white and be suitable for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

#### 2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent with a low flash point (flash point less than minus 25 degrees F when tested in accordance with ASTM D 3278) or, dispersed in a nonflammable organic solvent which shall not have a fire point below 200 degrees F. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The adhesive shall be nonflammable and fire resistant.

#### 2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

#### 2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

#### 2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449/C 449M.

#### 2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with

ASTM E 84. Fibrous glass cloth and tape shall be 20 x 20 maximum size mesh. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard.

#### 2.1.7 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

#### 2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pound/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pound/inchwidth. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.1 White Vapor Retarder ASJ (All Service Jacket)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.2 NOT USED

##### 2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch. Insulation under PVC jacket shall meet jacket manufacturer's written recommendations.

#### 2.1.9 Vapor Retarder Coating

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall not exceed 0.05 perm and shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. The flash point of the compound shall not be less than 80 degrees F and shall be determined in accordance with ASTM D 3278. All other application and service properties shall be in accordance with ASTM C 647.

##### 2.1.10 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

#### 2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be as follows:

##### 2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F shall be as follows:

###### 2.2.1.1 Cellular Glass

ASTM C 552, Type II, and Type III.

###### 2.2.1.2 Flexible Cellular Insulation

ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both

sides of the insulation.

#### 2.2.1.3 Phenolic Insulation

ASTM C 1126, Type III. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

#### 2.2.2 Aboveground Hot Pipeline

For aboveground hot pipeline above 60 degrees F insulation the following requirements shall be met.

##### 2.2.2.1 Mineral Fiber

ASTM C 547, Class 1 or Class 2 as required for the operating temperature range.

##### 2.2.2.2 Calcium Silicate

ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature.

##### 2.2.2.3 Cellular Glass

ASTM C 552, Type II and Type III.

##### 2.2.2.4 Flexible Cellular Insulation

ASTM C 534, Type I or II to 200 degrees F service.

##### 2.2.2.5 Phenolic Insulation

ASTM C 1126 Type III to 250 F service. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

#### 2.2.3 Below ground Pipeline Insulation

ASTM C 552, Type II.

#### 2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be as follows:

##### 2.3.1 Rigid Mineral Fiber

ASTM C 612, Class 1.

##### 2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-2.

##### 2.3.3 Cellular Glass

ASTM C 552, Type I.

##### 2.3.4 Phenolic Foam

ASTM C 1126 Type II. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

##### 2.3.5 Flexible Cellular

ASTM C 534 Type II.

### PART 3 EXECUTION

#### 3.1 APPLICATION - GENERAL

##### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until [tests] [tests and heat tracing] specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the drawings.

##### 3.1.2 Fire stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07270 FIRE STOPPING.

##### 3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTING, GENERAL.

##### 3.1.4 Flexible Cellular Insulation

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry.

##### 3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

##### 3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required, unless stated otherwise, on all pipes, ducts, or equipment, which operate at or below 60 F and at or above 80 F.

#### 3.2 PIPE INSULATION INSTALLATION

##### 3.2.1 Pipe Insulation

###### 3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a

single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Unions in pipe above 60 degrees F.
- e. Strainers in pipe above 60 degrees F.
- f. Check valves in pipe above 60 degrees F.
- g. Air chambers.

#### 3.2.1.2 Pipes Passing Through Sleeves

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.
- e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.
- f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.
- g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

#### 3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.
- b. Horizontal pipes larger than 2 inches at 60 degrees F and above

shall be supported on hangers in accordance with MSS SP-69, and Section 15400 PLUMBING, GENERAL PURPOSE.

- c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass or calcium silicate shall be installed above each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.
- d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.
- e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

#### 3.2.1.4 Pipes Passing Through Walls

- a. For hot water pipes supplying lavatories or other similar heated service which requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. Caulk the annular space between the pipe and wall penetration. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inch.
- b. For domestic cold water pipes requiring insulation, the insulation shall be terminated on the finished side of the wall (i.e.

insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Caulk the annular space between the pipe and wall penetration. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inch.

3.2.1.5 Flexible Cellular Pipe Insulation

Flexible cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere insulation directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.2 Aboveground Cold Pipelines

The following shall be included for aboveground cold pipelines minus 30 degrees to plus 60 degrees F:

- a. Domestic cold water.
- b. Make-up water.
- c. Refrigerant suction lines.
- d. Air conditioner condensate drains.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service	Material	Runouts up to 2 in*	1 in & less	1.25 - 2 in
Refrigerant suction piping	CG		1.5	1.5
	FC		1.0	1.0
	PF		1.0	1.0
Cold domestic water, above and below ceilings	CG	1.5	1.5	1.5
	FC	3/8	3/8	3/8
	PF	3/8	3/8	3/8
Exposed lavatory drains exposed domestic water piping & drains to areas for handicap personnel	FC	0.5	0.5	0.5
	MF	0.5	1.0	1.0
Air	FC		3/8	0.5

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service	Material	Runouts up to 2 in*	1 in & less	1.25 - 2 in
conditioning condensate drain located inside building	PF		3/8	3/8

\*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like main feed pipe.

LEGEND:

- PF - Phenolic Foam
- CG - Cellular Glass
- CS - Calcium Silicate
- MF - Mineral Fiber
- FC - Flexible Cellular

3.2.2.2 Jacket for Fibrous, Cellular Glass, and Phenolic Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket.

3.2.2.3 Insulation for Straight Runs (Fibrous, Cellular Glass and Phenolic Foam)

- a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor retarder coating at intervals not to exceed 15 feet.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating.
- f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating. The patch shall extend not less than 1-1/2 inches past the break.
- g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.

#### 3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall have ends thoroughly coated with a vapor retarder coating not less than 6 inches from each flange, union, valve, anchor, or fitting in all directions.
- b. Precut, preformed insulation for placement over fittings, flanges, unions, valves, anchors, and mechanical couplings shall be used. Precut, preformed insulation shall exhibit the same properties as the adjoining pipe insulation. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow.
- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.
- e. Flexible connections at pumps and other equipment shall be insulated with 0.59 inch flexible cellular insulation, unless otherwise indicated.
- f. Insulation shall be marked showing the location of unions, strainers, and check valves.

#### 3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same thickness as adjoining pipe insulation and the insulation shall be protected with one coat of vapor retarder coating under the PVC cover. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

#### 3.2.3 Aboveground Hot Pipelines

For hot pipelines above 60 degrees F the following shall be included:

- a. Domestic hot water.

##### 3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

##### LEGEND:

PF - Phenolic Foam

- CG - Cellular Glass
- CS - Calcium Silicate
- MF - Mineral Fiber
- FC - Flexible Cellular

Table II - Hot Piping Insulation Thickness  
Pipe Size (inches)

Type of Service (degrees F)	Material	Runouts up to 2 in	1 in & less	1.25 - 2 in
Hot domestic water supply & recirculating system (200 F max)	CG	1.5	1.5	1.5
	FC	0.5	1.0	1.0
	PF	0.5	1.0	1.0
	MF	0.5	1.0	1.0

\*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

3.2.3.2 Jacket for Insulated Pipe

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.
- f. Flexible cellular pipe insulation shall be installed by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 6 inches shall not be

stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

#### 3.2.3.4 Insulation for Fittings and Accessories

- a. The run of the line pipe insulation shall have the ends brought up to the item.
- b. Insulation of the same thickness and conductivity as the adjoining pipe insulation, either premolded or segmented, shall be placed around the item abutting the adjoining pipe insulation, or if nesting size insulation is used, overlapping 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3 inch size shall be premolded. Insulation for elbows 3 inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall have not less than 3 segments per elbow. Insulation may be wired or taped on until finish is applied.
- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of Class 1 adhesive applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16 inch.
- d. Insulation terminations shall be tapered to unions at a 45-degree angle.
- e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers.

#### 3.2.4 NOT USED

##### 3.2.4.1 NOT USED

##### 3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be used with PVC lagging and adhesive welded moisture tight.

##### 3.2.4.3 PVC Lagging

PVC lagging shall be ultraviolet resistant and adhesive welded vapor tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

#### 3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be

installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

### 3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III.

Table III - Minimum Duct Insulation (inches)

Cold and Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

### 3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder for cold air duct below 60 degrees F: Ducts and associated equipment shall be insulated to a thickness which is in accordance with Table III. The following shall be insulated:

- a. Supply ducts.
- b. Return air ducts.
- c. Relief ducts.
- d. Flexible runouts (field-insulated).
- e. Fresh air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I jacket; or, a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I all service jacket. Insulation for exposed ducts shall be provided with either a white, paintable, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Fibrous and cellular glass insulation on concealed duct shall be provided with a factory-applied Type I vapor retarder jacket. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any uninsulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation.

#### 3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.
- f. Jacket overlaps shall be secured under the overlap with Class 2 adhesive and stapled on 4 inch centers. Staples and seams shall be coated with a brush coat of vapor retarder coating.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

#### 3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.
- b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.
- d. Joints in the insulation jacket shall be sealed with a 4 inchwide strip of the same material as the vapor retarder jacket. The

strip shall be secured with Class 2 adhesive and stapled. Staples and seams shall be sealed with a brush coat of vapor retarder coating.

- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with Class 2 adhesive and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide stripe on 12 inch centers.

### 3.3.3 NOT USED

### 3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

### 3.3.5 NOT USED

### 3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

-- End of Section --

## SECTION 15400

## PLUMBING, GENERAL PURPOSE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22 (1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 74 (1996) Cast Iron Soil Pipe and Fittings

ASTM A 105/A 105M (1996) Carbon Steel Forgings for Piping Applications

ASTM A 193/A 193M (1997a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 515/A 515M (1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

ASTM A 516/A 516M (1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

ASTM A 888 (1996) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B 32 (1996) Solder Metal

ASTM B 88 (1996) Seamless Copper Water Tube

ASTM B 88M (1996) Seamless Copper Water Tube (Metric)

ASTM B 370 (1992) Copper Sheet and Strip for Building Construction

ASTM B 641 (1993) Seamless and Welded Copper Distribution Tube (Type D)

ASTM B 813 (1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C 564 (1995a) Rubber Gaskets for Cast Iron Soil

## Pipe and Fittings

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM D 2235	(1996a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3122	(1995) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1995) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1996a) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E 1	(1995) ASTM Thermometers
ASTM F 409	(1995) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1993a) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	(1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
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## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE ANSI/ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE ANSI/ASSE 1003	(1995) Water Pressure Reducing Valves for Domestic Water Supply Systems

ASSE 1005 (1986) Water Heater Drain Valves -  
3/4-Inch Iron Pipe Size

ASSE ANSI/ASSE 1011 (1995) Hose Connection Vacuum Breakers

ASSE ANSI/ASSE 1012 (1995) Backflow Preventers with  
Intermediate Atmospheric Vent

ASSE 1013 (1993) Reduced Pressure Principle Backflow  
Preventers

ASSE ANSI/ASSE 1037 (1986; Rev thru Mar 1990) Pressurized  
Flushing Devices (Flushometers) for  
Plumbing Fixtures

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01 (1995) Standard Methods for the  
Examination of Water and Wastewater

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA ANSI/AWWA C105/A21.5 (1993) Polyethylene Encasement for  
Ductile-Iron Pipe Systems

AWWA C203 (1991) Coal-Tar Protective Coatings and  
Linings for Steel Water Pipelines - Enamel  
and Tape - Hot-Applied

AWWA C606 (1987) Grooved and Shouldered Joints

AWWA M20 (1973) Manual: Water Chlorination  
Principles and Practices

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze  
Welding

AWS B2.2 (1991) Brazing Procedure and Performance  
Qualification

## CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (1995) Hubless Cast Iron Soil Pipe and  
Fittings for Sanitary and Storm Drain,  
Waste, and Vent Piping Applications

CISPI 310 (1995) Coupling for Use in Connection with  
Hubless Cast Iron Soil Pipe and Fittings  
for Sanitary and Storm Drain, Waste, and  
Vent Piping Applications

CISPI HSN-85 (1985) Neoprene Rubber Gaskets for Hub and  
Spigot Cast Iron Soil Pipe and Fittings

## CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 430 Energy Conservation Program for Consumer  
Products

## COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA-02 (1995) Copper Tube Handbook  
 COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1 (1992; Errata Jun 1993) Accessible and Usable Buildings and Facilities  
 FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCCHR-01 (1993) Manual of Cross-Connection Control  
 MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (1995) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1990) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends

MSS SP-72 (1992) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73 (1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-78 (1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-85 (1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

MSS SP-110 (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01 (1996) National Standard Plumbing Code  
 NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)  
 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 14 (1996) Plastics Piping Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1991) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 1508 (1996) Hose Clamps

UNDERWRITERS LABORATORIES (UL)

UL 174 (1996; Rev thru Nov 1997) Household Electric Storage Tank Water Heaters

## 1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

## 1.3 NOT USED

## 1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Vibration-Absorbing Features; GA.

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

SD-04 Drawings

Plumbing System; GA.

Detail drawings consisting of illustrations, schedules, performance charts,

instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics; GA.

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

#### SD-06 Instructions

Plumbing System; GA.

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

#### SD-09 Reports

Tests, Flushing and Disinfection ; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests; FIO.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

#### SD-13 Certificates

Materials and Equipment; GA.

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts; FIO.

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

## SD-19 Operation and Maintenance Manuals

Plumbing System; GA.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

## 1.6 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with NAPHCC-01.

## 1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II.

Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF ANSI/NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

## 2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- d. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.
- e. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

- f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.
- g. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- k. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- l. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- m. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- n. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- o. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.
- p. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.
- q. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

#### 2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J 1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:

AWWA C203.

- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Polyethylene Encasement for Ductile-Iron Piping: AWWA ANSI/AWWA C105/A21.5.
- l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.
- m. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ASSE ANSI/ASSE 1001
Water Pressure Reducing Valves	ASSE ANSI/ASSE 1003
Water Heater Drain Valves	ASSE 1005

Description	Standard
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22

#### 2.3.1 NOT USED

#### 2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

#### 2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

#### 2.3.4 NOT USED

#### 2.3.5 NOT USED

#### 2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.

Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face

plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

## 2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE ANSI/ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE ANSI/ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE ANSI/ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

## 2.6 DRAINS

### 2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.2 NOT USED

2.6.3 NOT USED

2.6.4 NOT USED

2.6.5 NOT USED

### 2.6.6 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded or caulked connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the

strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	36 square inches
Height of funnel	3-3/4 inches
Diameter of lower portion of funnel	2 inches
Diameter of upper portion of funnel	4 inches

2.7 NOT USED

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 NOT USED

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls with an adjustable range that includes 90 to 120 degrees F. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.10.1 Automatic Storage Type

Heaters shall be complete with control system, and shall have ASME rated combination pressure and temperature relief valve.

2.10.1.1 NOT USED

2.10.1.2 NOT USED

2.10.1.3 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 1.5 KW. The elements shall be wired so that only one element can operate at a time.

2.10.1.4 Point-of-use, Tankless, Electric Water Heater

Point-of-use electric water heater conforming to applicable requirements of UL 499. Manufacturer's standard construction without hot-water storage.

Electric heating system shall be manufacturer's standard electric-resistance type. Jacket shall be aluminum or steel with baked-on enamel finish. Provide bracket or device for wall mounting. Provide adjustable thermostat for temperature control. Provide automatic high-temperature-limit cutoff.

2.11 NOT USED

2.12 NOT USED

2.13 NOT USED

2.14 COMPRESSED AIR SYSTEM

2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 1 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensates before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated.

The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.14.2 Lubricated Compressors

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

2.14.3 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

#### 2.14.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

#### 2.14.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

#### 2.14.6 Pressure Regulators / Filter Combination

Regulator: Diaphragm type, air loaded, tight closing single seat, brass body.

Filter: 125 psig operating pressure and filter housing of brass or bronze. Provide cellulose cartridge filters of graded density construction capable of removing liquids and solids of 5 microns and larger. Filter capacity shall be compatible with rated flow of equipment or pressure reducing valves provided.

Both Regulator and Filter shall be attached to a common metallic bracket pre-drilled for wall mounting.

#### 2.15 LOW PRESSURE AIR DRYERS

Provide low pressure compressed air dryers of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger and a main compressed air cooling exchanger. Refrigeration system shall cool compressed air to dry the air. Dryer shall have no internal traps or filters and shall have pressure drop not greater than 3 psi. Air shall leave the dryer at a dew point of 38 degrees F, based on an inlet temperature of 100 degrees F. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary.

##### 2.15.1 Air Circuit

a. Regenerate Heat Exchanger: Inlet compressed air to outlet compressed air heat exchanger designed to reduce cooling load at design conditions minus 7 degrees C 20 degrees F inlet air precooling.

b. Main Heat Exchanger: Single-pass, with air in the tubes, heat sink, direct expansion, or flooded cooler type.

c. Separator: Fabricated in accordance with ASME B31.1; code stamp not required; moisture separator low velocity type incorporating change of air flow direction to prevent moisture carryover.

d. Dryer Operating Pressure: 125 psig working pressure.

e. Drain Line: Provide with exterior mounted condensate trap to facilitate servicing.

##### 2.15.2 Refrigeration System

- a. Refrigeration Compressor: ARI 520. Hermetic, semi-hermetic, or open reciprocating type equipped with automatic start-stop or unloading capacity control; standard components include inherent motor protection, crankcase oil strainer, and suction screen. Refrigerant shall be R-22.
- b. Dryer Controls: Capable of automatic 0 to 100 percent capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.
- c. Refrigerant dryer and suction line strainer.
- d. Air-cooled condenser, with condenser fan and motor.

### 2.15.3 Instrumentation and Control

Include control panel in the dryer cabinet containing:

- a. Indicators for the Following Services: Inlet air pressure gage, discharge air pressure gage, inlet air temperature gage, main exchanger temperature gage, refrigeration compressor suction pressure gage, refrigeration compressor discharge pressure gage, green "Power On" light, power interruption light, and high temperature light.
- b. Electrical Relays: Locate in an enclosed portion of the panel, accessible for ease of servicing.
- c. Controls and Interlocks: To maintain required compressed air dew point and to cycle air-cooled condenser with refrigeration compressor.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

#### 3.1.1 Water Pipe, Fittings, and Connections

##### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture,

except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

#### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

#### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

#### 3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

#### 3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided,

toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

#### 3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

#### 3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

##### 3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

##### 3.1.3.2 NOT USED

##### 3.1.3.3 Union and Flanged

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

##### 3.1.3.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

##### 3.1.3.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiframe torch.

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA-02 with flux and are acceptable for line sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing

filler metal.

- b. Soldered. Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA-02.
- c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

#### 3.1.3.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

#### 3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

#### 3.1.5 Corrosion Protection for Buried Pipe and Fittings

##### 3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA ANSI/AWWA C105/A21.5. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

##### 3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

#### 3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

##### 3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs

shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

#### 3.1.6.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be

installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

#### 3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

#### 3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

#### 3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

#### 3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

#### 3.1.8 Supports

##### 3.1.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of

the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 NOT USED

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
  - (1) Be used on insulated pipe less than 4 inches.
  - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
  - (3) Have a high density insert for pipe 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 8 pcf or greater.

1. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
  - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
  - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
  - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.
- o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

### 3.1.9 NOT USED

### 3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where

cleanouts are provided with adjustable heads, the heads shall be cast iron or plastic.

### 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

#### 3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

#### 3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.3 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

#### 3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

#### 3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor.

### 3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

### 3.3.4 NOT USED

### 3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

#### 3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

#### 3.3.5.2 Support for Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

#### 3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

#### 3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

#### 3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

### 3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC-01 at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed

at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

### 3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

### 3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

### 3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

## 3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 5 percent of the lowest equipment rpm.

### 3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

## 3.5 NOT USED

## 3.6 IDENTIFICATION SYSTEMS

### 3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

### 3.6.2 Color Coding

Color coding for piping identification shall be as specified in Section 09900 PAINTING, GENERAL.

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with NAPHCC-01.

- a. Drainage and Vent Systems Tests.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of
Gauges	

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 NOT USED

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of

screwed joints or holes will not be acceptable.

### 3.9.3 System Flushing

Before tests, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

### 3.9.4 Operational Test

Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

### 3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a

solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in proper disinfection containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.10 PLUMBING FIXTURE SCHEDULE

#### P-1 WATER CLOSET HANDICAPPED:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, wall hung.

Gasket shall be wax type.

Seat - ANSI Z124.5, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE ANSI/ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 1.6 gallons per flush. Height of top rim of bowl shall be in accordance with CABO A117.1.

#### P-1A WATER CLOSET TANK TYPE HANDICAPPED:

ASME A112.19.2M, close-coupled, white vitreous china, water conservation type, floor-mounted, floor outlet reverse trap, elongated bowl, white solid plastic elongated open-front seat with cover, and ASME A112.19.5 trim. Nonfloat swing type flush valves are not acceptable. Water flushing volume shall not exceed 1.6 gallons per flush.

#### P-3 URINAL:

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 1 gallon per flush.

#### P-2 WHEELCHAIR LAVATORY:

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 20 inches wide x 27 inches deep with gooseneck spout. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water

pressure of 80 psi. Lavatory suitable for countertop installation, self-rimming. Verify counter dimensions prior to submittals.

Drain - Strainer shall be copper alloy or stainless steel.

#### P-4 KITCHEN SINK:

Ledge back with holes for faucet and spout double bowl 32 x 21 inches stainless steel ASME A112.19.3M. Verify counter dimensions prior to submittals.

Faucet and Spout - Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

EEW-1 - Emergency Eye Wash: Head Emergency Eye and Face Wash. Shower control shall be 1 inch stay-open type control valve. Unit shall be corrosion-resisting steel and shall be floor mounted.

### 3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

### 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

#### 3.12.1 Storage Water Heaters

##### 3.12.1.1 Electric

- a. Storage capacity of 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

- b. Storage capacity of more than 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

3.13 TABLES

TABLE I  
PIPE AND FITTING MATERIALS FOR  
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE				
		A	B	C	D	E
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X	X	X	

SERVICE:

- A - Underground Building Soil, Waste and Storm Drain
- B - Aboveground Soil, Waste, Drain In Buildings
- C - Underground Vent
- D - Aboveground Vent
- E - Interior Rainwater Conductors Aboveground
- F - Corrosive Waste And Vent Above And Belowground
- \* - Hard Temper

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
1	Steel pipe: a. Seamless, black, ASTM A 53, Type S, Grade B	X	X	X X	X
2	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
3	Seamless and welded copper distribution tube (Type D) ASTM B 641	X**	X**	X**	X****
4	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 8 and 9	X	X	X	X

A - Cold Water Aboveground  
B - Hot Water 180 degrees F Maximum Aboveground  
C - Compressed Air Lubricated  
D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

\*\* - Type L - Hard

\*\*\* - Type K - Hard temper with brazed joints only or type K-soft temper  
without joints in or under floors

\*\*\*\* - In or under slab floors only brazed joints

TABLE III  
 STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING  
 EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	120 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum

TERMS:

- EF = Energy factor, overall efficiency.
- ET = Thermal efficiency with 70 degrees F delta T.
- EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).
- SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.
- HL = Heat loss of tank surface area
- V = Storage volume in gallons

-- End of Section --

## SECTION 15653

## AIR-CONDITIONING SYSTEM (UNITARY TYPE)

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI ANSI/ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 460	(1994) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI ANSI/ARI 710	(1986) Liquid-Line Driers
ARI ANSI/ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1994) Thermostatic Refrigerant Expansion Valves
ARI 760	(1994) Solenoid Valves for Use with Volatile Refrigerants

## AIR DIFFUSION COUNCIL (ADC)

ADC 1062:GRD	(1984) Test Codes for Grilles, Registers and Diffusers
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## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(1994) Test Methods for Louvers, Dampers and Shutters
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## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the Identification of Piping Systems
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 653/A 653M	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 280	(1995a) Seamless Copper Tube for Air Conditioning and Refrigeration Field

## Service

ASTM C 534 (1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM D 520 (1984; R 1995) Zinc Dust Pigment

ASTM D 3308 (1991a) PTFE Resin Skived Tape

ASTM E 437 (1992) Industrial Wire Cloth and Screens (Square Opening Series)

ASTM F 104 (1993) Nonmetallic Gasket Materials

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 (1994) Safety Code for Mechanical Refrigeration

ASHRAE 52.1 (1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1 (1995; B31.1a; B31.1b; B31.1c) Power Piping

ASME B31.5 (1992; B31.5a) Refrigeration Piping

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1 (1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX (1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

## AMERICAN WELDING SOCIETY (AWS)

AWS-01 (1991) Brazing Handbook

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

AWS D1.1 (1996) Structural Welding Code - Steel

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Industrial Control and Systems, Enclosures

NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators
NEMA MG 2	(1989) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1996; Errata 96-4) National Electrical Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems
NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)	
NAIMA AH115	(1993) Fibrous Glass Duct Construction Standards
SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)	
SMACNA-05	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA-06	(1995) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-10	(1985) HVAC Air Duct Leakage Test Manual
UNDERWRITERS LABORATORIES (UL)	
UL 181	(1996; Rev Oct 1996) Factory-Made Air Ducts and Air Connectors
UL 214	(1997) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1995) Fire Dampers
UL 586	(1996) High-Efficiency, Particulate, Air Filter Units
UL 900	(1994; Rev thru Apr 1997) Test Performance of Air Filter Units
UL 1995	(1995; Rev thru Feb 97) Heating and Cooling Equipment
UL Bld Mat Dir	(1997) Building Materials Directory
UL Elec Const Dir	(1997) Electrical Construction Equipment Directory
UL Fire Resist Dir	(1997) Fire Resistance Directory (2 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Air-Conditioning/Heat Pump System; FIO.

Manufacturer's standard catalog data, prior to the purchase or installation of a particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements. Data shall be submitted for each specified component. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

## SD-04 Drawings

Air-Conditioning/Heat Pump System; FIO.

Drawings shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

- (1) Equipment layouts which identify assembly and installation details.
- (2) Piping layouts which identify valves and fittings.
- (3) Plans and elevations which identify clearances required for maintenance and operation.
- (4) Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- (5) Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.
- (6) Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- (7) Automatic temperature control diagrams and control sequences.
- (8) Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

## SD-06 Instructions

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

## SD-07 Schedules

Tests; FIO.

A letter, at least 10 working days in advance of each tests, advising the Contracting Officer of the test. Individual letters shall be submitted for the condenser water system, refrigerant system, ductwork leak tests, cooling tower tests, condenser water quality tests, and the system performance tests. Each letter shall identify the date, time, and location for each test.

Demonstrations; GA.

A letter, at least 14 working days prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions; FIO.

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

#### SD-09 Reports

Tests; GA.

Six copies of each test containing the information described below in bound 8-1/2 x 11 inch booklets. Individual reports shall be submitted for the condenser water system, refrigerant system, ductwork leak tests, and the cooling tower tests.

- (1) The date the tests were performed.
- (2) A list of equipment used, with calibration certifications.
- (3) Initial test summaries.
- (4) Repairs/adjustments performed.
- (5) Final test results.

System Performance Tests; GA.

Six copies of the report shall be provided in bound 8-1/2 x 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

- (1) Date and outside weather conditions.
- (2) The load on the system based on the following:
  - (a) The refrigerant used in the system.
  - (b) Condensing temperature and pressure.
  - (c) Suction temperature and pressure.
  - (d) Ambient, condensing and coolant temperatures
  - (e) Running current, voltage and proper phase sequence for each phase of all motors.
- (3) The actual on-site setting of operating and safety controls.
- (4) Thermostatic expansion valve superheat - value as determined by field test

- (5) Subcooling
- (6) High and low refrigerant temperature switch set-points
- (7) Low oil pressure switch set-point
- (8) Defrost system timer and thermostat set-points
- (9) Moisture content
- (10) Capacity control set-points
- (11) Field data and adjustments which affect unit performance and energy consumption.
- (12) Field adjustments and settings which were not permanently marked as an integral part of a device.

#### SD-13 Certificates

##### Air-Conditioning/Heat Pump System.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

#### SD-19 Operation and Maintenance Manuals

##### Operation Manual; FIO.

Six complete copies of an operation manual in bound 8-1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

##### Maintenance Manual; FIO.

Six complete copies of maintenance manual in bound 8-1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

### 1.3 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the

tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of all material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

#### 1.5 PROJECT/SITE CONDITIONS

##### 1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

##### 1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Equipment, ductwork, and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

#### 2.2 NAMEPLATES

Major equipment including compressors, condensers, receivers, heat exchanges, fans, cooling towers, pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

#### 2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in

accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

## 2.4 MISCELLANEOUS MATERIALS

### 2.4.1 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

### 2.4.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

### 2.4.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

### 2.4.4 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

### 2.4.5 Pressure and Vacuum Gauge

Gauge shall conform to ASME B40.1, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

### 2.4.6 Temperature Gauges

Industrial duty thermometers shall be provided for the required temperature range. Thermometers shall have Fahrenheit scale in 2 degree graduations scale on a white face. The pointer shall be adjustable.

#### 2.4.6.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube.

#### 2.4.6.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

#### 2.4.6.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

#### 2.4.6.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

#### 2.4.7 Unicellular Plastic Foam

Unicellular plastic foam shall be in accordance with ASTM C 534, Form T, except that D-Factor shall not exceed 0.28 at 75 degrees F mean temperature.

#### 2.4.8 Bird Screen

Screen shall be in accordance with ASTM E 437, Type 1, Class 1, 2 by 2 mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

### 2.5 UNITARY EQUIPMENT, ROOM UNIT

#### 2.5.1 NOT USED

#### 2.5.2 Packaged Terminal Unit (PTAC-2.1)

Unit shall be a through-the-wall mounted, heavy-duty commercial grade, factory assembled and precharged heat pump unit. Unit shall be in accordance with ARI 310/380/CSA C744 and UL 1995. Units shall be removable from inside the building for servicing without removing the outside cabinet. Heat pump units shall contain a reversing valve to change unit to heating cycle. An outdoor coil temperature sensor shall be provided to guard against coil freeze-up by either switching to supplemental heat only, or by cycling the compressor to defrost the coil.

#### 2.5.3 Compressor

Compressor shall be hermetically sealed reciprocating, rotary, or scroll type. Compressor shall be fitted with permanent split capacitor motor, overload protection, and vibration isolators. Compressor shall be protected against high discharge pressure, loss of charge, low voltage, and short cycling.

#### 2.5.4 Air-To-Refrigerant Coils

Evaporator and condenser coils shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 3 mil thick phenolic or vinyl coating. Casing shall be galvanized steel or

aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. A condensate removal system shall be provided.

#### 2.5.5 Fans

Indoor and outdoor fans shall be the centrifugal, direct driven type. Fans shall be statically and dynamically balanced. Outdoor fan shall be designed so that condensate will evaporate without drip, splash, or spray on building exterior. Indoor fan shall be provided with a minimum two-speed motor with built-in overload protection. Fan motors shall be the inherently protected, permanent split-capacitor type.

#### 2.5.6 Air Filters

Filters shall be of the sectional or panel cleanable type and be capable of filtering the entire air supply.

#### 2.5.7 Primary/Supplemental Heat

Supplemental heat shall be provided as specified in paragraph "System Components".

#### 2.5.8 Cabinet Construction

Cabinet shall be free of visible fasteners, sharp protuberances and edges. Enclosure sheet metal shall be a minimum of 18 gauge steel with a protective coating. Face panels shall be removable and shall provide full access to unit appurtenances. Access to controls shall be without removal of the face panel. Conditioned air shall discharge through adjustable louvers. Cabinet shall be thermally and acoustically insulated with materials which conform to NFPA 90A. Units shall be furnished with a field-wired subbase. Subbase shall have leveling screws with provisions for remote unit control. Subbase shall be of 18 gauge galvanized steel construction with a protective coating to match that of the room cabinet. Paint and finishes shall comply with the requirements specified in paragraph "Factory Coating".

#### 2.5.9 Wall Sleeve

Louver shall be stormproof type, constructed of anodized, stamped or extruded aluminum. Sleeve shall be a water and airtight completely insulated assembly, with weather-resistant protective coating.

#### 2.5.10 Duct Package

Duct extension shall consist of 18 gauge minimum galvanized steel plenum extender with all necessary internal dampers and baffles to divert the supply air as indicated. Duct extension shall be painted with a protective coating that matches room cabinet.

#### 2.5.11 Unit Controls

Controls shall include an on-off switch, high and low selector switch for both the heating and cooling mode, multiple speed fan cooling and heating mode, room air fan switch, outside air damper control, and an adjustable cooling and heating thermostat. Function and temperature controls shall be remotely mounted as indicated.

#### 2.6 NOT USED

## 2.7 UNITARY EQUIPMENT, SPLIT SYSTEM (AC-3.1 and HP-3.1)

Unit shall be an air-cooled, split system which employs a remote condensing unit, a separate indoor unit, and interconnecting refrigerant piping. Unit shall be the heat pump type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with ARI ANSI/ARI 210/240. Unit shall be provided with necessary fans, air filters, coil frost protection, internal dampers, mixing boxes, supplemental heat, and cabinet construction as specified in paragraph "System Components". The remote unit shall be as specified in paragraph REMOTE CONDENSER OR CONDENSING UNIT. Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Condenser or outdoor fans shall be the manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors shall have totally enclosed enclosures.

### 2.7.1 Air-to-Refrigerant Coil

Coils shall have nonferrous tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 3 mil thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge.

Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

### 2.7.2 NOT USED

### 2.7.3 Refrigeration Circuit

Refrigerant-containing components shall comply with ASHRAE 15 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type. Refrigerant flow control devices shall be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve.

### 2.7.4 Unit Controls

Unit shall be internally prewired with a 24 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure, and safety interlocks on all service panels. Head pressure controls shall sustain unit operation with ambient temperature of 0 degrees F. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995.

### 2.8 NOT USED

### 2.9 NOT USED

### 2.10 REMOTE CONDENSING UNIT (HP-3.1)

Each remote condenser coil shall be fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing

temperature shall not exceed 120 degrees F at 95 degrees F ambient. Unit shall be provided with low ambient condenser controls to ensure proper operation in an ambient temperature of 0 degrees F as well as a short cycle compressor relay. Fan and cabinet construction shall be provided as specified in paragraph "System Components". Fan and condenser motors shall have totally enclosed enclosures.

#### 2.10.1 Air-Cooled Condenser

Unit shall be rated in accordance with ARI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

##### 2.10.1.1 Connections

Interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit shall be provided as required and as indicated. Electrical and refrigeration piping terminal connections between heat pump condensing unit and evaporator units shall be provided.

##### 2.10.1.2 Head Pressure Control and Liquid Subcooling

Low ambient control using condenser fan motor speed modulation shall provide condenser pressure controls for the refrigerant circuit. Controls shall be set to produce a minimum of 95 degrees F saturated refrigerant condensing temperature. Unit shall be provided with a liquid subcooling circuit which shall ensure proper liquid refrigerant flow to the expansion device over the specified application range of the condenser. Unit shall be provide with manufacturer's standard liquid subcooling. Subcooling circuit shall be liquid sealed.

##### 2.10.1.3 Condensing Coil

Coils shall have nonferrous tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 3 mil thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

##### 2.10.1.4 Unit Controls

The control system shall be complete with required accessories for regulating condenser pressure by fan cycling, solid-state variable fan speed, modulating condenser coil or fan dampers, flooding the condenser, or a combination of the above. Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include control transformer, fan motor starters, time delay start-up, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

##### 2.10.2 NOT USED

##### 2.10.3 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating,

or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Units 120,000 Btuh and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

2.11 NOT USED

2.12 SYSTEM COMPONENTS

2.12.1 NOT USED

2.12.2 NOT USED

2.12.3 Supplemental Heating (AC-3.1)

2.12.3.1 NOT USED

2.12.3.2 NOT USED

2.12.3.3 Electric Heating Coil

Coil shall be an electric duct heater in accordance with UL 1995 and NFPA 70.

Coil shall be duct- or unit-mounted. Coil shall be of the nickel chromium resistor, two stage, strip type. Coil shall be provided with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Coil casing and support brackets shall be of galvanized steel or aluminum. Coil shall be mounted to eliminate noise from expansion and contraction and be completely accessible for service.

2.12.4 Air Filters

Air filters shall be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test Method shall be as listed under the label service and shall meet the requirements of UL 586.

2.12.4.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth sectional type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested in accordance with ASHRAE 52.1. Initial resistance at 500 feet per minute will not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. Four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.12.5 Coil Frost Protection

Each circuit shall be provided with a coil frost protection system which is a manufacturer's standard. The coil frost protection system shall use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Timers shall be used to prevent the compressor from rapid cycling.

2.13 NOT USED

2.14 NOT USED

2.15 NOT USED

2.16 NOT USED

2.17 NOT USED

2.18 NOT USED

2.19 NOT USED

2.20 NOT USED

2.21 NOT USED

2.22 NOT USED

2.23 TEMPERATURE CONTROLS

Temperature controls shall be in accordance with Section 15950 HEATING, VENTILATING AND AIR OCNDITIONING HVAC CONTROL SYSTEMS.

2.24 DUCTWORK COMPONENTS

2.24.1 Metal Ductwork

All ductwork shall be galvanized with G90 coating. Every aspect of metal ductwork construction, including fittings and components, shall comply with SMACNA-06 unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. Class 3 through 10 inch shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA-06. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable.

2.24.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.24.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or

negative working pressure of 15 inches water gauge at 350 degrees F when duct is aluminum, and 650 degrees F when duct is galvanized steel or stainless steel.

#### 2.24.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runouts shall not exceed 10 feet in length, shall be preinsulated, factory fabricated, and comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulation material surface shall not be exposed to the air stream.

#### 2.24.1.4 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

#### 2.24.2 NOT USED

#### 2.24.3 Ductwork Insulation

Ductwork insulation and related materials shall conform to the requirements of Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.24.4 Ductwork Accessories

##### 2.24.4.1 Duct Access Doors

Access doors shall be provided in ductwork where indicated and at all air flow measuring devices, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA-06. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 x 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 x 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

##### 2.24.4.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the

assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA-05 and in manufacturer's instructions for fire dampers shall be followed.

#### 2.24.4.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing.

Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

#### 2.24.4.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at all duct mounted supply outlets, at all takeoff or extension collars to supply outlets, at all duct branch takeoff connections, and at all 90 degree elbows, as well as at all locations as indicated on the drawings or shown in the Sheet Metal and Air Contractors National Association manuals. Air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein before. Fixed air deflectors, also called turning vanes, shall be provided in all 90 degree elbows. Turning vanes shall be designed as shown in the Sheet Metal and Air Condition Contractors National Association manuals.

#### 2.24.5 Duct Sleeves, Framed Prepared Openings, Closure Collars

##### 2.24.5.1 Duct Sleeves

Duct sleeves shall be provided for all round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and all square, rectangular, and oval ducts passing

through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

#### 2.24.5.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

#### 2.24.5.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and all square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

#### 2.24.6 NOT USED

#### 2.24.7 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified in accordance with ADC 1062:GRD. Inlets and outlets shall be sound rated and certified in accordance with ADC 1062:GRD. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers.

##### 2.24.7.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with antismudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

#### 2.24.7.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

#### 2.24.8 Louvers

Louvers shall be furnished for installation in exterior walls which are directly connected by ductwork to air handling equipment. Louver blades shall be fabricated from anodized aluminum or galvanized steel sheets, and shall be provided with a frame of galvanized steel or aluminum structural shapes. Sheet metal thickness and fabrication shall conform to SMACNA-06. Blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Louver shall be provided with bird screen. Louvers shall bear AMCA Certified Ratings Seal for air performance and water penetration ratings as described in AMCA 500.

#### 2.25 NOT USED

#### 2.26 REFRIGERANT PIPING

Refrigerant piping, valves, fittings, and accessories shall conform to the requirements of ASHRAE 15 and ASME B31.5, except as specified.

##### 2.26.1 NOT USED

##### 2.26.2 NOT USED

##### 2.26.3 NOT USED

##### 2.26.4 NOT USED

##### 2.26.5 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inch and smaller may be flared.

##### 2.26.6 Joints and Fittings, Copper Tubing

Copper tube joints and fittings shall be flare joint type with short-shank flare, or solder-joint pressure type. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints.

##### 2.26.7 Valves

Valves shall be pressure and temperature rated for contained refrigerant service and shall comply with ASME B31.5. Metals of construction shall be ferrous or copper based. Atmosphere exposed valve stems shall be stainless steel or corrosion resistant metal plated carbon steel. Valve body connections shall be brazed or welded socket, flanged or combination thereof. Threaded connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges

cannot be used. Valves shall be suitable for or fitted with extended copper ends for brazing in-place without disassembly. Ferrous body valves shall be fitted with factory fabricated and brazed copper transitions. To minimize system pressure drops, where practicable, globe valves shall be angle body type, and straight line valves shall be full port ball type. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by manufacturer. Valves shall be cleaned and sealed moisture-tight.

#### 2.26.7.1 Refrigerant-Stop Valves

Valves, in sizes through 5/8 inch, shall be handwheel operated, straight or angle, packless diaphragm globe type with back-seating stem, brazed ends, except where SAE flare or retained seal cap connections are required.

In sizes over 5/8 inch, valves shall be globe or angle type, wrench operated with ground-finish stems, or ball valves, packed especially for refrigerant service, back seated, and provided with seal caps. Refrigerant isolation and shut-off valves shall have retained or captive spindles and facilities for tightening or replacement of the gland packing under line pressure as applicable. Stop valves shall have back-seating plated steel stem, bolted bonnet in sizes 1-1/8 inches OD and larger, integral or flanged transition brazed socket. Valves in sizes through 2-1/2 inches shall be end-entry body assembly, full-port, floating ball type, with equalizing orifice fitted chrome plated ball, seats and seals of tetrafluoroethylene, chrome plated or stainless steel stem, and seal cap. In sizes 4 inch IPS and larger, and in smaller sizes where carbon steel piping is used, valve bodies shall be tongue and groove flanged and complete with mating flange, gaskets and bolting for socket or butt-weld connection. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

#### 2.26.7.2 Check Valves

Valve shall be designed for service application, spring-loaded type where required, with resilient seat and with flanged body in sizes 1/2 inch and larger. Valve shall provide positive shut-off at 1-1/2 psi differential pressure.

#### 2.26.7.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

#### 2.26.7.4 Expansion Valves

Expansion valves conform to requirements of ARI 750. Valve shall be of the diaphragm and spring type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator

pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads.

#### 2.26.7.5 Safety Relief Valve

Valve shall be the two-way type. Single type valves shall be used only where indicated. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

#### 2.26.7.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring power assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

#### 2.26.7.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with ARI ANSI/ARI 720.

#### 2.26.8 Accessories

##### 2.26.8.1 Filter Driers

Driers shall conform to ARI ANSI/ARI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psi.

##### 2.26.8.2 Sight Glass and Liquid Level Indicator

- a. Assembly and Components: Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.
- b. Gauge Glass: Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.
- c. Bull's-Eye and Inline Sight Glass Reflex Lens: Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighting viewing shall be provided.
- d. Moisture Indicator: Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be

furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

#### 2.26.8.3 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

#### 2.26.8.4 NOT USED

#### 2.26.8.5 NOT USED

#### 2.26.8.6 Brazing Materials

Brazing materials for refrigerant piping shall be in accordance with AWS A5.8, Classification BCuP-5.

### 2.27 DRAIN AND MISCELLANEOUS PIPING

Piping, fittings, valves and accessories for drain and miscellaneous services shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

### 2.28 FABRICATION

#### 2.28.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B 117 using a 25 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

#### 2.28.2 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

#### 3.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of

machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

### 3.1.2 Mechanical Room Ventilation

Mechanical rooms containing refrigeration components or equipment shall be ventilated to the outdoors as indicated. Refrigerant relief device vent piping which is not returned to the system shall be routed to the atmosphere as indicated. Relief piping shall be supported independently of relief device and braced against reaction forces. The ventilation system shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

### 3.1.3 Building Surface Penetrations

Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

#### 3.1.3.1 NOT USED

#### 3.1.3.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07900 JOINT SEALING.

#### 3.1.3.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17-ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

- a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.
- b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal. Rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

#### 3.1.3.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07840 FIRESTOPPING.

#### 3.1.3.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

#### 3.1.4 Access Panels

Access panels shall be provided for all concealed valves vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METALS.

#### 3.1.5 General Piping Installation

##### 3.1.5.1 Brazed Joints

Brazing shall be performed in accordance with AWS-01, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

### 3.1.5.2 Threaded Joints

Threaded joints shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

### 3.1.5.3 Welded Joints

Welded joints in steel refrigerant piping shall be fusion-welded. Changes in direction of piping shall be made with welded fittings only; mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. Branch connections shall be made with welding tees or forged welding branch outlets. Steel pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

### 3.1.5.4 Flanged Joints

Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for use with the refrigerants to be handled. When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, refrigeration equipment, control valves, and other similar items.

### 3.1.5.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

### 3.1.6 NOT USED

### 3.1.7 Refrigeration Piping

Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.5. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made.

#### 3.1.7.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

#### 3.1.7.2 Functional Requirements

Piping shall be installed 1/2 inch per 10 feet of pipe in the direction of

flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings.

#### 3.1.7.3 Manual Valves

Stop valves shall be installed on each side of each piece of equipment such as compressors, condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Angle and globe valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

#### 3.1.7.4 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

#### 3.1.7.5 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

#### 3.1.7.6 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

#### 3.1.7.7 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices and where indicated. Strainers may be an integral part of the expansion valve.

#### 3.1.7.8 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturers recommendations. A dryer shall be installed such that it can be isolated from the system,

the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

#### 3.1.7.9 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of filter dryers and where indicated. Sight glass shall be full line size.

#### 3.1.7.10 Flexible Connectors

Flexible metallic connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

#### 3.1.8 Thermometers

Thermometers located within 5 feet of floor may be rigid stem type. Where thermal well is located above 5 feet above floor, thermometer shall be universal adjustable angle type or remote element type to 7 feet above floor and remote element type where thermal well is 7 feet or more above floor. Thermometers shall be located in coolant supply and return or waste lines at each heat exchanger, condenser water lines entering and leaving the condenser, at each automatic temperature control device without an integral thermometer, refrigerant liquid line leaving receiver, refrigerant suction line at each evaporator or liquid cooler, and where indicated or required for proper operation of equipment.

#### 3.1.9 Piping Supports

Refrigerant pipe supports shall be in accordance with ASME B31.5. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

##### 3.1.9.1 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05210 STRUCTURAL STEEL.

##### 3.1.9.2 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Material used for support shall be as specified under Section 05210 STRUCTURAL STEEL.

##### 3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be

used.

3.1.11 NOT USED

3.1.12 NOT USED

3.1.13 NOT USED

3.1.14 Piping Identification

Each piping system and direction of fluid flow shall be identified in accordance with applicable provisions of ANSI A13.1 with color coded, water, moisture and broad-spectrum temperature resistant, plastic labels.

3.1.15 Metal Ductwork

Installation shall be in accordance with SMACNA-06 unless otherwise indicated. Duct supports for sheet metal ductwork shall be in accordance with SMACNA-06, unless otherwise specified. Friction beam clamps indicated in SMACNA-06 will not be used. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.16 NOT USED

Installation shall be in accordance with the manufacturer's written recommendations unless otherwise required in NAIMA AH115. Duct supports for fibrous glass ductwork shall conform to NAIMA AH115. In those cases not covered in NAIMA AH115, the written recommendation of the fibrous duct manufacturer shall be followed.

3.1.17 NOT USED

3.1.18 Field Applied Insulation

Field applied insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.19 NOT USED

3.1.20 Framed Instructions

Framed instructions shall be framed under glass or laminated plastic and be posted where directed. Instructions shall include equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The instructions shall be posted before acceptance testing of the system.

3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Utilities for testing shall be provided as specified in the SPECIAL CONTRACT REQUIREMENTS. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be

coordinated with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

### 3.2.1 NOT USED

### 3.2.2 Refrigerant System

After all components of the refrigerant system have been installed and connected, the entire refrigeration system shall be subjected to a pneumatic test as described herein.

#### 3.2.2.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

#### 3.2.2.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

#### 3.2.2.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

#### 3.2.2.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures.

Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

#### 3.2.2.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

#### 3.2.2.6 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim.

At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

#### 3.2.3 Ductwork Leak Tests

Ductwork leak test shall be performed for the entire air distribution system, including fans, coils, filters, etc. Test procedure, apparatus, and report shall conform to SMACNA-10. The maximum allowable leakage rate is 200 CFM. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

#### 3.3 NOT USED

#### 3.4 CLEANING AND ADJUSTING

##### 3.4.1 NOT USED

##### 3.4.2 Ductwork

Prior to testing, inside of ducts, plenums, and casing shall be thoroughly cleaned of all debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Temporary filters shall be provided for fans that are operated during construction. New filters shall be installed after all construction dirt has been removed from the building and the ducts, plenum, casings, and other items specified have been vacuum cleaned. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

##### 3.4.3 Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring

adjustment shall be adjusted to setting indicated or directed.

#### 3.4.4 Testing, Adjusting, and Balancing

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

#### 3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 2 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

## SECTION 15835

## TERMINAL HEAT TRANSFER UNITS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Electric unit heaters.

## 1.2 PRODUCTS FURNISHED AND INSTALLED UNDER OTHER SECTIONS

- A. Section 15950 - Heating, Ventilating and Air Conditioning HVAC Control Systems: Installation of room thermostats.

## 1.3 RELATED SECTIONS

- A. Section 15950 - Heating, Ventilating and Air Conditioning HVAC Control Systems.
- B. Section 16180 - Equipment Wiring Systems: Electrical supply to units.

1.4 CODES AND STANDARDS  
(Latest Edition or Revision)

- A. NFPA 70 - National Electrical Code.
- B. ARI 440 - Room Fan Coil Air Conditioners.
- C. UL 883 - Safety Standards for Fan Coil Units and Room Fan Heater Units.

## 1.5 SUBMITTALS: Submit shop drawings under provisions of Section 01300.

- A. SD-04 Shop Drawings

Terminal Heat Transfer Units; GA.

Submit shop drawings indicating cross section of cabinets, grille, bracing and reinforcing, and typical elevation.

- B. SD-01 Product Data

Terminal Heat Transfer Units; GA.

Submit product data indicating typical catalog of information including arrangements.

Installation Instructions: Terminal Heat Transfer Units; GA.

- C. Schedules: Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

- D. Service Location: Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.

- E. Installation Instructions: Submit manufacturer's installation instructions under provisions of Section 01300.

## 1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 01700.

- B. Accurately record actual locations of access doors in radiation cabinets required for access or valving.

## 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01700.
- B. Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

## 1.9 REGULATORY REQUIREMENTS

- A. Conform to applicable code for internal wiring of factory wired equipment.

## 1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Division 1.
- B. Store and protect products under provisions of Division 1.
- C. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

## 1.11 SEQUENCING AND SCHEDULING

- A. Sequence work under the provisions of Division 1.
- B. Schedule work under the provisions of Division 1.
- C. Install radiation, convectors, fan-coil units, unit ventilators and radiant heaters (equipment exposed to finished areas) after walls and ceiling are finished and painted. Avoid damage.

## 1.12 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Division 1.
- B. Warranty: Include coverage of unit heater motors.

## PART 2 PRODUCTS

## 2.1 ELECTRIC UNIT HEATERS - EXPLOSION-PROOF

- A. Contractors shall supply and install Markel type HLA explosion-proof suspended fan-forced unit heaters of the capacity and voltage listed on the plans. Heaters shall be UL listed for Class 1, Group D, Divisions 1 & 2 and Class II, Groups E, F, and G, Divisions 1 & 2, UL temperature code shall be T3B (165°C) for Class 1, and T3B (165°C) for Class II, indicating maximum operating surface temperatures.
- B. Heat exchangers shall be heavy walled, liquid filled, with three, low watt density, immersion type copper sheathed elements hermetically sealed into the core along with the high limit thermal cut-out. Heat transfer fluid shall be ethylene-glycol solution, protected to -45°C (-49°F).
- C. Motors shall be PSC, explosion-proof, permanently lubricated, ball bearing type, 1725 rpm.
- D. Contactors shall be built-in and pre-wired into an explosion-proof enclosure. Contactors shall be heavy-duty and break all ungrounded conductors and be rated for 100,000 cycles at full load. Control transformers shall be built-in and pre-wired. Control circuits shall be

24 volt.

- E. Cabinet shall be 14 gauge cold rolled steel, epoxy coated plated fan guard shall have less than 1/4 inch spacing to conform with OSHA requirements. All fasteners shall be zinc plated. Heater conduits shall be cadmium plated seamless steel or aluminum.

## 2.2 ACCEPTABLE MANUFACTURERS - ELECTRIC UNIT HEATERS

- A. Markel Products Co., Models are as listed below.

EUH 1.1 M# HLA12-208360-7.5-24  
Explosion-Proof Suspended horizontal

EUH 1.2 M# HLA12-208360-7.5-24  
Explosion-Proof Suspended horizontal

EUH 1.3 M# HLA12-208360-7.5-24  
Explosion-Proof Suspended horizontal

EUH 1.4 M# F3452-T  
Wall-Hung Surface Mount

EUH 2.1 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.2 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.3 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.4 CAT # F2F5107CA1L  
Suspended Horizontal

EUH 2.5 M# F3452-T  
Wall-Hung Surface Mount

EUH 2.6 M# 3311TS-RP  
Architectural Recessed

EUH 3.1 M# F3452-T  
Wall-Hung Surface Mount

EUH 4.1 CAT # F2F5110CA1L  
Suspended Horizontal

Refer to the drawings for additional descriptions and requirements.

## 2.3 ELECTRIC UNIT HEATERS - STANDARD TYPE, NON-EXPLOSION-PROOF

- A. Assembly: UL listed and labelled assembly with terminal box and cover, and controls as indicated.
- B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
- C. Cabinet: 18 gage (1.3 mm) steel with easily removed front panel with integral air outlet and inlet grilles.
- D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

- F. Motor: Horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- G. Control: Separate fan speed switch and thermostat (where indicated) heat selector switch, factory wired, with switches built-in behind cover. Provide thermal overload.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and opening dimensions are as instructed by the manufacturer.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Beginning of installation means installer accepts existing surfaces.

#### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- C. Protect units with protective covers during balance of construction.
- D. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 sections.

#### 3.3 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION

## SECTION 15895

## AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline D (1987) Application and Installation of Central Station Air-Handling Units

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA ANSI/AMCA 210 (1985) Laboratory Methods of Testing Fans for Rating

AMCA 300 (1996) Reverberant Room Method for Sound Testing of Fans

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA Std 9 (1990) Load Ratings and Fatigue Life for Ball Bearings

ABEMA Std 11 (1990) Load Ratings and Fatigue Life for Roller Bearings

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993; Rev 1; Rev 2; Rev 3) Motors and Generators

## SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-10 (1985) HVAC Air Duct Leakage Test Manual

## 1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

## 1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Components and Equipment Data; FIO.

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Piping Components
- b. Ductwork Components
- c. Air Systems Equipment
- d. Air Handling Units
- e. Energy Recovery Devices
- f. Terminal Units

## SD-04 Drawings

Air Supply, Distribution, Ventilation, and Exhaust Equipment; FIO.

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

## SD-06 Instructions

Test Procedures; FIO.

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures; FIO.

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; GA.

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

## SD-07 Schedules

Test Schedules; FIO.

Proposed test schedules for hydrostatic test of piping, ductwork leak test,

and performance tests, at least 2 weeks prior to the start of related testing.

Field Training Schedule; FIO.

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

#### SD-08 Statements

Similar Services; FIO.

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welding Qualification; FIO.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

#### SD-09 Reports

Test Reports; FIO.

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

#### SD-13 Certificates

Bolts; FIO.

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

#### SD-19 Operation and Maintenance Manuals

Air Supply, Distribution, Ventilation, and Exhaust Manuals; FIO.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is

offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

## 2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

## 2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

## 2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

## 2.5 NOT USED

## 2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 10 hp or less. Adjustable frequency drives shall be used for larger motors.

## 2.7 CONTROLS

Controls shall be provided as specified in Section 15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS.

## 2.8 DUCTWORK COMPONENTS

Refer to Section 15653 AIR CONDITIONING SYSTEM (UNITARY TYPE).

## 2.9 AIR SYSTEMS EQUIPMENT

### 2.9.1 Fans

Fans shall be tested and rated according to AMCA ANSI/AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch

sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts.

Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 NOT USED

2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing.

Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA Std 9 and ABEMA Std 11. Motors shall have open or explosion-proof enclosure.

2.9.1.3 NOT USED

2.9.1.4 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 24 inches diameter shall be direct or V-belt driven and fans with wheels 24 inches diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof or explosion-proof type. Gravity or motor operated backdraft dampers shall be provided where indicated.

2.9.1.5 NOT USED

2.9.1.6 NOT USED

2.9.1.7 NOT USED

2.9.1.8 NOT USED

2.9.1.9 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

## PART 3 EXECUTION

## 3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

## 3.2 NOT USED

## 3.3 NOT USED

## 3.4 DUCTWORK LEAK TEST

Ductwork leak test shall be performed for the entire air distribution and exhaust system, including fans, and coils. Test procedure, apparatus, and report shall conform to SMACNA-10. The maximum allowable leakage rate is 5% of design airflow. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

## 3.5 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of fans, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

## 3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

## 3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 1 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient

temperature and humidity in a shaded and weather protected area.

### 3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

## SECTION 15950

## HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500 (1994) Test Methods for Louvers, Dampers and Shutters

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 88 (1996) Seamless Copper Water Tube

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1 (1995; Addenda Dec 1995, Dec 1996, Dec 1997) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

## ISA (ISA)

ISA S7.0.01 (1975; R 1981) Quality Standard for Instrument Air

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

## UNDERWRITERS LABORATORIES (UL)

UL 268A (1993; Rev thru May 1997) Smoke Detectors for Duct Application

UL 508 (1993; Rev thru Oct 1997) Industrial Control Equipment

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 1.2.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Equipment Compliance Booklet; FIO.

An HVAC control system equipment compliance booklet (ECB) in indexed booklet form with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a bill of materials for each HVAC control system. The bill of materials shall function as the table of contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB.

##### SD-04 Drawings

HVAC Control System; FIO.

Drawings on A1 34 by 22 inch sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and device identifiers shown. Each control-system element on a drawing shall have a unique identifier as shown. All HVAC control system drawings shall be delivered together as a complete submittal. Drawings shall be submitted for each HVAC system.

##### a. HVAC control system drawings shall include the following:

Sheet One: Drawing index, HVAC control system legend.

Sheet Two: Valve schedule, damper schedule.

Sheet Three: Compressed air station schematic.

Sheet Four: HVAC control system schematic and equipment schedule.

Sheet Five: HVAC control system sequence of operation and ladder diagram.

Sheet Six: HVAC control panel arrangement, control panel cross-section, and control panel inner door layout.

Sheet Seven: HVAC control panel back-panel layout.

Sheet Eight: Control loop wiring diagrams.

Sheet Nine: Motor starter and relay wiring diagram, including all additions and changes to starters specified in Division 16.

Note: Repeat sheets four through nine for each AHU system.

- b. An HVAC control system drawing index showing the name and number of the building, military site, State or other similar designation, and Country. The drawing index shall list all HVAC control system drawings, including the drawing number, sheet number, drawing title, and computer filename when used.
- c. An HVAC control system legend showing generic symbols and the name of devices shown on the HVAC control system drawings.
- d. A valve schedule showing each valve's unique identifier, size, flow coefficient (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data.
- e. A damper schedule showing each damper and actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The damper schedule shall include the maximum leakage rate at the operating static-pressure differential. The damper schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements.
- f. A compressed-air station schematic diagram showing all equipment, including: compressor with motor horsepower and voltage; starter; isolators; manual bypasses; tubing sizes; drain piping and drain traps; reducing valves; dryer; and data on manufacturer's names and model numbers, mounting, access, and clearance requirements. Air compressor and air dryer data shall include calculations of the air consumption of current-to-pneumatic transducers and any other control system devices to be connected to the compressed air station, and the compressed air supply dewpoint temperature at 20 psig.
- g. An HVAC control system equipment schedule showing the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e. output range).
- h. An HVAC control system sequence of operation.
- I. An HVAC control system ladder diagram showing all relays, contacts, pilot lights, switches, fuses and starters connected to the control system.
- j. HVAC control panel arrangement drawings showing both side and front views of the panel. The drawing shall show panel and mounting dimensions.
- k. HVAC control panel cross-section drawings showing mounting rails and standoffs for devices.
- l. HVAC control panel inner door layout drawings showing both front

and rear views of the inner door. The drawings shall show device locations, labels, nameplate legends, and fabrication details.

- m. HVAC control panel back-panel layout drawings showing device locations, labels, nameplate legends, terminal block layout, fabrication details, and enclosure operating temperature-rise calculations.
- n. HVAC control system wiring diagrams showing functional wiring diagrams of the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show all necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged-equipment control systems shall be identified back to the panel-board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown.

#### SD-08 Statements

##### Commissioning Procedures; FIO .

- a. Six copies of the HVAC control system commissioning procedures, in indexed booklet form, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal-unit control system. The commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.
- b. Commissioning procedures documenting detailed, product-specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product-specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.
- c. Commissioning procedures documenting controller configuration checksheets for each controller listing all configuration parameters, dip switch and jumper settings, and initial recommended P, I and D values. The configuration parameters shall be listed in the order in which they appear during the configuration process. Each configuration parameter shall be noted as being: set per specs with no field adjustment required, set per specs but field adjustable, or not applicable.
- d. Commissioning procedures showing a time clock configuration checksheet listing all parameters, and switch settings. The parameters shall be listed in the order which they appear during the setup process.
- e. An HVAC control system commissioning procedures equipment list that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

##### Performance Verification Test Procedures; FIO.

Six copies of the HVAC control system performance verification test procedures, in indexed booklet form, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Training Course Materials; FIO.

Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course. An HVAC control system training course, in outline form, with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training.

#### SD-09 Reports

Commissioning Report; FIO.

Six copies of the HVAC control system commissioning report, in indexed booklet form, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning and shall follow the format of the commissioning procedures. The commissioning report shall include all controller and time clock checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, and results of adjustments.

Performance Verification Test Report; FIO.

Six copies of the HVAC control system performance verification test report, in indexed booklet form, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

#### SD-13 Certificates

ASME Air-Storage Tank Certificate; FIO.

An ASME Air-Storage Tank Certificate for each storage tank.

#### SD-18 Records

Service Organizations; FIO.

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

#### SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Maintenance and Repair Manual; FIO.

Six copies of the HVAC control system operation manual for each HVAC control system 30 days before the date scheduled for the training course.

#### 1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

#### 1.5 OPERATION MANUAL

An HVAC control system operation manual for each HVAC control system, in indexed booklet form, shall be provided. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built controller configuration checksheets, the as-built time clock configuration checksheet, the HVAC control system front panel description, the procedures for changing HVAC system controller setpoints, the procedures for gaining manual control of processes, the time clock manufacturer's manual control of processes, the time clock manufacturer's operation manual, and the controller manufacturer's operation manual.

- a. The HVAC control system front panel description shall explain the meaning and use of the lights, switches, gauges, and controller displays located in the front panel. Each light, switch, gauge, and display described shall be numbered and referenced to a drawing of the front panel.
- b. The procedures for changing HVAC system controller setpoints shall describe the step-by-step procedures required to change: the process variable setpoints of controllers, the alarm setpoints of controllers, the controller bias settings, and controller setpoint reset schedules.
- c. The procedures for gaining manual control of processes shall describe step-by-step procedures required to gain manual control of devices and manually adjust their positions.

### PART 2 PRODUCTS

#### 2.1 MATERIAL AND EQUIPMENT

Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. The Contractor shall submit a certified list of qualified permanent service organizations and qualifications. These service organizations shall be reasonably convenient to the equipment on a regular and emergency basis during the warranty period.

## 2.2 GENERAL EQUIPMENT REQUIREMENTS

### 2.2.1 Electrical and Electronic Devices

All electrical, electronic, and electro-pneumatic devices not located within an HVAC control panel shall have a NEMA Type 1 enclosure in accordance with NEMA 250 unless otherwise shown.

### 2.2.2 Standard Signals

The output of all analog transmitters and the analog input and output of all single-loop controllers and function modules shall be 4-to-20 mA dc signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

### 2.2.3 Ambient Temperature Limits

Ambient Temperature Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of 40 to 140 degrees F. All panel-mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. All devices installed outdoors shall operate within limit ratings of minus 40 to plus 150 degrees F.

### 2.2.4 Nameplates, Lens Caps, and Tag Nameplates

Nameplates, lens caps, and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each air flow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

### 2.2.5 Year 2000 Compliance

All equipment shall be Year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if other information technology properly exchanges date/time data with it.

## 2.3 MATERIALS

### 2.3.1 Tubing

#### 2.3.1.1 Copper

Copper tubing shall conform to ASTM B 88 and shall have sweat fittings and valves.

### 2.3.2 Wiring

#### 2.3.2.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

#### 2.3.2.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

#### 2.3.2.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

#### 2.3.2.4 Analog Signal Wiring Circuits

Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-volt service.

#### 2.3.2.5 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

#### 2.3.2.6 Nonconducting Wiring Duct

Nonconducting wiring duct in control panels shall have wiring duct in control panels shall have slotted sides, snap-on duct covers, have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips.

#### 2.3.2.7 Transformers

Step-down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformers shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508.

### 2.4 ACTUATORS

Actuators shall be pneumatic, electric and electronic as shown and shall be provided with mounting and connecting hardware. Contractor shall have the option of utilizing pneumatic systems in the Inspection Building (See Control Sequences). Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. Electric actuators shall have an oil-immersed gear train. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric or electronic actuators used in sequencing applications shall have an adjustable operating range and start point. Pneumatic actuators shall be rated for 25 psig operating pressure except for high-pressure cylinder-type actuators.

#### 2.4.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

#### 2.4.2 Positive Positioners

Positive positioners are required for pneumatic actuators. Each positive positioner shall be a pneumatic relay with a mechanical feedback mechanism and an adjustable operating range and starting point.

## 2.5 AUTOMATIC CONTROL VALVES

### 2.5.1 Valve Assembly

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv.

### 2.5.2 NOT USED

### 2.5.3 NOT USED

### 2.5.4 NOT USED

### 2.5.5 NOT USED

### 2.5.6 Solenoid Valve for Water Storage Tank Fill

Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Valve Cv shall be within 100 percent to 125 percent of the Cv shown. Internal valve trim shall be brass or bronze except that valve stems may be type 316 stainless steel.

## 2.6 DAMPERS

### 2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.

#### 2.6.1.1 Operating Links

Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

#### 2.6.1.2 Damper Types

Dampers shall be parallel blade type.

### 2.6.2 NOT USED

### 2.6.3 Mechanical and Electrical Space Ventilation Dampers

The dampers shall be as shown. Dampers shall not leak in excess of 80 cfm per square foot at 4 inches water (gauge) static pressure when closed. Dampers shall be rated at not less than 1500 fpm air velocity.

### 2.6.4 NOT USED

### 2.6.5 Damper End Switches

Each end switch shall be a hermetically-sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

## 2.7 DUCT SMOKE DETECTORS

Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the HVAC control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as each affected fan unit shall be properly identified in etched rigid plastic placards.

## 2.8 INSTRUMENTATION

### 2.8.1 Measurements

Transmitters shall be factory calibrated to provide an output of 4 to 20 mAdc over the indicated ranges:

- a. Relative humidity, 0 to 100 percent for space and duct high-limit applications.

### 2.8.2 NOT USED

### 2.8.3 Relative-Humidity Instruments

A relative-humidity instrument for indoor application shall have a measurement range from 0 to 100 percent relative-humidity and be rated for operation at ambient air temperatures within the range of 25 to 130 degrees F. It shall be capable of being exposed to a condensing air stream 100 percent RH with no adverse effect to the sensor's calibration or other harm to the instrument. The instrument shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Instruments used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted instruments shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The instrument (sensing element and transmitter) shall be a 2-wire, loop-powered device and shall have an accuracy of plus or minus 3 percent of full scale within the range of 20 to 80 percent relative humidity. The instrument shall have a typical long-term stability of 1 percent or less drift per year. The transmitter shall convert the sensing element's output to a linear 4-20 mAdc output signal in proportion to the measured relative-humidity value. The transmitter shall include offset and span

adjustments.

2.8.4 NOT USED

2.8.5 NOT USED

2.8.6 NOT USED

2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension-type well, and inside diameter and insertion length as required for the application.

2.9 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric.

2.9.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT) or DPDT as required, hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards). Thermostats shall have manual switches as required by the application.

2.9.2 Microprocessor-Based Room Thermostats

Microprocessor-based thermostats shall have built-in keypads for scheduling of day and night temperature settings. Access to the scheduling mode shall be by a password control code. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all 7 days of the week. The time program shall allow 2 separate temperature-setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for 1 year in the event of a power outage. Maximum differential shall be 2 degrees F. When used for heat-pump applications, the thermostat shall have an emergency heat switch. Thermostats shall have auxillary relay(s) as required by the control sequence.

2.9.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards).

2.9.4 NOT USED

2.9.5 NOT USED

2.9.6 NOT USED

2.9.7 Fan-Coil Unit Room Thermostats

#### 2.9.7.1 Heating Thermostats

Fan-coil heating thermostats shall be provided with fixed heat anticipation and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set maximum of 72 degrees F. Heating thermostats shall have an adjustable range of at least 13 degrees below 72 degrees F.

#### 2.9.7.2 Cooling Thermostats

Fan-coil cooling thermostats shall be provided with fixed cooling anticipation heater and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set minimum of 78 degrees F. Cooling thermostats shall have an adjustable range of at least 7 degrees F above 78 degrees F.

#### 2.9.7.3 Dual Element Thermostats

Fan-coil unit combination heating-cooling thermostats shall be provided with separate temperature sensing elements for each system, and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Each element shall operate switches to provide single stage control for heating and cooling. Heating and cooling circuits shall be electrically isolated from each other. Scales and ranges shall be as specified for individual thermostats. Thermostats shall contain, or a subbase shall be provided which contains, selector switches for Heat-Off-Cool. A changeover controller providing automatic summer-winter changeover for thermostats by sensing the supplied fluid temperature shall be provided. A limited range heating-cooling dead band thermostat shall control cooling when temperature is above the upper setpoint and heating when temperature is below the lower setpoint and shall have a dead band, with no heating or cooling, when temperature is between the setpoints. Setpoint adjustment shall be concealed.

### 2.10 PRESSURE SWITCHES AND SOLENOID VALVES

#### 2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

#### 2.10.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

#### 2.10.3 Pneumatic Electric (PE) Switches

Each switch shall have an adjustable setpoint range of 3 to 20 psig with a switching differential adjustable from 2 to 5 psig. The switch action shall be SPDT.

#### 2.10.4 Solenoid-Operated Pneumatic (EP) Valves

Each valve shall have three-port operation: common, normally open, and normally closed. Each valve shall have an outer cast-aluminum body and

internal parts of brass, bronze, or stainless steel. The air connection shall be a 3/8 inch NPT threaded connection. Valves shall be rated for 50 psig when used in a control system that operates at 25 psig or less, or 150 psig when used in a control system that operates in the range of 25 to 100 psig.

## 2.11 INDICATING DEVICES

### 2.11.1 Thermometers

#### 2.11.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

#### 2.11.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

#### 2.11.1.3 Non-Averaging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism. Install for operations Building AC-1, supply and return air.

#### 2.11.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

#### 2.11.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Thermometers shall have a range suitable for the application.

### 2.11.2 Pressure Gauges

Gauges shall be 2 inch (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 3 percent of scale range. Gauges shall meet requirements of ASME B40.1.

#### 2.11.2.1 Pneumatic Actuator Gauges

Field mounted gauges for indicating signal input to pneumatic actuators shall have a scale of 0 to 30 psig with 1 psig graduations.

#### 2.11.2.2 Air Storage Tank, Filter, and Dryer Gauges

Gauges for air storage tanks, or for use before and after dryers or dirt and oil filters, shall have a scale of 0 to 160 psig with 2 psig graduations.

#### 2.11.2.3 NOT USED

#### 2.11.2.4 Control Panel Pressure Gauges

Panel mounted air pressure gauges shall have a scale of 0 to 30 psig with 1 psig graduations.

### 2.11.3 Low Differential Pressure Gauges

Gauges for low differential-pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

## 2.12 SINGLE-LOOP CONTROLLERS

### 2.12.1 Controller Features

The controller shall be a microprocessor-based single-loop device that does not require Contractor generated software. The controller shall be mountable in a panel cutout measuring 3.62 by 3.62 inches. The controller shall have field scalable process variable, a remote setpoint analog input and an analog output with adjustable high and low end limits and proportional control manual reset adjustment. The analog output shall result from proportional, integral and derivative (PID) control. The analog output shall be configurable as direct acting and reverse acting. The controller shall have keyboard, display, auto/manual selection for control of its analog output, remote setpoint adjustment/local setpoint adjustment selection with adjustable high-end and low-end limits, ratio and bias adjustments on remote setpoint input, operator-initiated self-tune/manual-tune selection, anti-reset wind-up feature, and 2 independent SPDT contact-closure outputs (PV alarm and deviation alarm). The controller shall be configurable to power-up in automatic with local setpoint control and in automatic with remote setpoint control. The range of hysteresis adjustment shall be not smaller than from 1 percent to 5 percent of process variable input span. The controller shall power the analog output loop to 20 milliamperes when connected to a load of 600 ohms. The controller shall be capable of retransmitting the process variable to 20 milliamperes when connected to 600 ohms. The controller shall have 5-year battery backup to store operating parameters or shall have nonvolatile memory.

### 2.12.2 Parameter Input and Display

Control parameters shall be entered and displayed directly, in the correct engineering units, through a series of keystrokes on a front-panel display with a 3-1/2 digit, 7-segment display, with decimal point and polarity indication. The use of this display shall allow manual interrogation of setpoint, mode constants, and values of the process variable and output.

### 2.12.3 Controller Electrical Requirements

Each controller shall be powered by 120 volts ac. Power consumption shall not be greater than 25 watts. Each controller shall provide electrical noise isolation between the ac power line and the process variable input, remote setpoint input, and output signals and of not less than 100 db at 60 Hz common-mode rejection ratio, and not less than 60 db at 60 Hz normal-mode rejection ratio.

### 2.12.4 Controller Accuracy

The controller shall have an accuracy of plus or minus 0.30 percent of input span, plus or minus 1 digit.

### 2.12.5 Self-Tuning

The controller self-tuning operation shall apply proportional, integral, and derivative modes of control and shall modify the mode constants as required. Self-tuning shall only be in operation when selected from the front panel.

### 2.12.6 Manual-Tuning

The controller manual-tuning operation shall provide proportional, integral, and derivative control modes, or any combination thereof, by means of individual mode constant adjustments. These adjustments shall be set for the appropriate value if a particular control mode action is desired, or to zero if that particular mode is not desired. The proportional-mode constant shall be adjustable from 0 to 200 percent of input signal range, the integral-mode constant shall be adjustable from 0 to 20 repeats per minute, and derivative-mode constant shall be adjustable from 0 to 5 minutes.

## 2.13 CONTROL DEVICES AND ACCESSORIES

Control device and accessory input impedance shall not exceed 250 ohms.

### 2.13.1 Function Modules

Function modules shall accept mAdc analog input signals to produce mAdc analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs. Module output span accuracy shall be plus or minus 1 percent of input span. Modules shall be rail-mounted as shown. Power consumption shall be not greater than 5 watts.

#### 2.13.1.1 Minimum-Position Switch and Temperature-Setpoint Device

Minimum-position switch and temperature-setpoint device shall accept a 1000 ohms potentiometer input and shall produce a steady analog output. In temperature setpoint applications the potentiometer shall be single-turn, suitable for wall mounting, enclosed in a locking metal or heavy duty plastic enclosure and shall have a graduated dial corresponding to the range of the setpoint adjustment. In a minimum position switch application the potentiometer shall be mounted on or internal to the minimum position switch. The device shall have its input signal electrically or optically isolated from output. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

#### 2.13.1.2 Signal-Inverter Modules

Signal inverter shall accept an analog input signal and shall have sufficient output capacity to drive the output signal through a circuit with an impedance of not less than 600 ohms. The output shall be electrically isolated from the input and the device shall have a moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

#### 2.13.1.3 High-Low Signal Selector

High-low signal-selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal. The signal selector shall be powered by 120 Vac and the output signal shall be electrically isolated from the input signal.

#### 2.13.1.4 Sequencer Modules (Dual Limit Alarm)

Sequencer modules (dual limit alarms) shall accept an analog input signal and shall provide two contact closure outputs. Each output shall have an adjustable independent contact setpoint with an adjustable switching differential range between 1 percent and 100 percent of the input span. The setpoint shall be adjustable between 0 percent and 100 percent of the input span. Setpoint and switching differential (dead band) adjustment potentiometers shall be internal, top-accessed potentiometers or screws. Sequencers shall return all contacts to their zero input signal condition

when power is interrupted. The device shall have moisture resistant coating.

#### 2.13.1.5 Loop Driver Modules

Loop driver module shall accept an analog input signal and shall have a circuit input impedance not greater than 100 ohms. The loop driver module shall have sufficient output capacity to drive the output signal through a circuit with an impedance range of not less than 1000 ohms. The output shall be electrically isolated from the input and the device shall have moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8 output signal.

#### 2.13.2 Relays

Relays shall be 2-pole, double-throw (2PDT) with a 10-ampere resistive rating at 120 Vac, and shall have an enclosed 120-Vac coil with 8 pin blade connectors, and a matching rail-mounted socket. Power consumption shall not be greater than 3 watts.

#### 2.13.3 Time-Delay Relays

Time delay relays shall be 2PDT with 8 pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall be not greater than 3 watts.

#### 2.13.4 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors. The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

#### 2.13.5 NOT USED

#### 2.13.6 Current-to-Pneumatic (IP) Transducers

The transducers shall be 2-wire current-to-pressure transmitters that convert a 4-to-20 mA<sub>dc</sub> input signal to a 3 to 15 psig, or a 15 to 3 psig, pneumatic output, with a conversion accuracy of plus or minus 2 percent of full scale, including linearity and hysteresis. Input impedance shall not exceed 250 ohms. Air consumption shall not be greater than 0.25 scfm.

#### 2.13.7 Direct Current (DC) Power Supply

One DC power supply shall be used to power all transmitters connected to the control panel. The power supply shall be 24 V<sub>dc</sub> at not less than 1.2 amperes, with a peak-to-peak ripple not to exceed 0.03 percent of output voltage. Each power supply shall have a fused input, and shall be protected from voltage surges and powerline transients. The power supply output shall be protected against overvoltage and short circuits.

#### 2.14 PILOT LIGHTS AND MANUAL SWITCHES

Pilot lights and switches shall be rectangular devices arranged in a horizontal matrix as shown. Momentary switches shall be non-illuminated. Interlocking switches shall have separately illuminated sections. Split legend lights shall have separately illuminated sections. Device illumination shall be by light-emitting diode or neon lamp.

#### 2.15 HVAC SYSTEM AND PUMPHOUSE CONTROL PANELS

##### 2.15.1 Panel Assembly

The control panel shall be factory assembled and shipped to the job site as a single unit. The panel shall be fabricated as shown, and the devices shall be mounted as shown. Each panel shall be fabricated as a bottom-entry connection point for control-system electric power, control-system main air source, control-system wiring, pneumatic tubing, interconnection of control systems, interconnection of starters and external shutdown devices, and energy monitoring and control systems (EMCS) interface. Each panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

#### 2.15.2 Panel Electrical Requirements

Each control panel shall be powered by nominal 120 volts ac, fused at 5 amps, terminating at the panel on terminal blocks. Instrument cases shall be grounded. Interior panel, interior door, and exterior panel enclosure shall be grounded.

#### 2.15.3 Enclosure

The enclosure for each panel shall be a NEMA 12 single-door wall-mounted box conforming to NEMA 250, with continuous hinged and gasketed exterior door with print pocket and key lock, continuous hinged interior door, interior back panel, and ventilation louvers in back surface as shown. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

#### 2.15.4 Mounting and Labeling

Controllers, pilot lights, switches, IP's, and pressure gauge shall be mounted on the interior door as shown. Power conditioner, fuses and duplex outlet shall be mounted on the interior of the cabinet as shown. All other components housed in the panel shall be mounted on the interior back panel surface of the enclosure, behind the door on rails as shown. Controllers and gauges mounted on the front of the inner door shall be identified by a plastic or metal nameplate as shown that is mechanically attached to the panel. Function modules, relays, timeclocks, IP transducers, DC power supply, and other devices interior to the panel shall be identified by a plastic or metal nameplate that is mechanically attached to the panel. The nameplate shall have the inscription as shown. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch, and shall show a contrasting color, produced by filling with enamel or lacquer or by the use of a laminated material. Painting of lettering directly on the surface of the interior door or panel is not permitted.

#### 2.15.5 Wiring and Tubing

##### 2.15.5.1 Current-to-Pneumatic Transducers (IP)

Current-to-pneumatic transducers (IP) shall be piped to bulkhead fittings in the bottom of the panel with a 2 inch loop to accommodate IP replacement and shall be wired to identified terminal blocks.

##### 2.15.5.2 Panel Wiring

Interconnections Wiring shall be installed in wiring ducts in such a way that devices can be added or replaced without disturbing wiring that is not affected by the change. Wiring to all devices shall have a 4 inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. All interconnections required for power or signals shall be made on device terminals or panel terminal blocks, with not more than two wires connected to a terminal.

##### 2.15.5.3 Panel Terminal Blocks

Terminal blocks shall be arranged in groups such that all connections

(power, ground shield, etc.) for a given device are adjacent. Instrument signal grounds at the same ground reference level shall end at a grounding terminal for connection to a common ground point. Wiring-shield grounds at the same reference level shall end at a grounding terminal for connection to a common ground point. Grounding terminal blocks shall be identified by reference level.

#### 2.15.5.4 Wiring Identification

All wiring connected to controllers, time clocks and function modules shall be identified by function and polarity with full word identifiers, i.e., process variable input, remote setpoint input and control output.

### 2.16 COMPRESSED-AIR STATIONS (CONTRACTOR'S OPTION: INSPECTION BUILDING ONLY)

#### 2.16.1 Air-Compressor Assembly

The air compressor shall be a high-pressure compressing unit with electric motor. The compressor shall be equipped with a motor with totally enclosed belt guard, an operating-pressure switch, safety-relief valves, gauges, intake filter and intake silencer, and combination type magnetic starter with undervoltage protection and thermal-overload protection for each phase, and shall be supported by a steel base mounted on an air storage tank. The air compressor shall provide the compressed air required for control operation while operating not more than one-third of the time. The air storage tank shall be fabricated for a working pressure of not less than 200 psig, and constructed and certified in accordance with ASME BPV VIII Div 1. The tank shall be of sufficient volume so that no more than six compressor starts per hour are required with the starting pressure switch differential set at 20 psig. The tank shall be provided with an automatic condensate drain trap with manual override feature.

#### 2.16.2 Compressed-Air Station Specialties

##### 2.16.2.1 Refrigerated Dryer, Filters and, Pressure Regulator

A refrigerated dryer shall be provided in the air outlet line of the air storage tank. The dryer shall be of the size required for the full delivery capacity of the compressor. The air shall be dried at a pressure of not less than 70 psig to a temperature not greater than 35 degrees F. The dryer shall be provided with an automatic condensate drain trap with manual override feature. The refrigerant used in the dryer shall be one of the fluorocarbon gases and have an Ozone Depletion Potential of not more than 0.05. A 5 micron prefilter and coalescing-type 0.03 micron oil removal filter with shut-off valves shall be provided in the dryer discharge. Each filter bowl shall be rated for 150 psig maximum working pressure. A pressure regulator, with high side and low side pressure gauges, and a safety valve shall be provided downstream of the filter. Pressure regulators of the relieving type shall not be used.

##### 2.16.2.2 Flexible Pipe Connections

The flexible pipe connectors shall be designed for 150 psig and 250 degrees F service, and shall be constructed of rubber, tetrafluoroethylene resin, or braided corrosion-resistant steel, bronze, monel, or galvanized steel. The connectors shall be suitable for the service intended and may have threaded or soldered ends. The length of the connectors shall be as recommended by the manufacturer for the service intended.

##### 2.16.2.3 Vibration-Isolation Units

The vibration-isolation units shall be standard products with published loading ratings, and shall be single rubber-in-shear, double rubber-in-shear, or spring type.

#### 2.16.2.4 Compressed Air Piping

Control air delivered to the system shall conform to ISA S7.0.01. Air lines for pneumatic controls shall be seamless copper tubing. Copper tubing shall be hard-drawn in exposed areas and either hard-drawn or annealed in concealed areas. Only tool-made bands shall be used. Fittings for copper tubing shall be brass or copper solder joint type except at connections to apparatus, where fittings shall be brass compression type. Air lines concealed in walls shall be hard-drawn copper tubing or nonmetallic tubing in rigid conduit. Terminal single lines shall be hard-drawn copper tubing, except when the run is less than 12 inches in length, flexible polyethylene may be used.

#### 2.17 WATER STORAGE TANK HEATERS

Tank heaters shall be dry-well open coil element electric immersion heaters as manufactured by Chromalox (or approved equal); Chromalox model OCE-15042-3VXX5204, 4.2 Kw, 208V, 3PH, 60 HZ, nominal 15 foot long, for mounting in sch 40 pipe, 3" diameter. Heaters shall be wrapped with ceramic insulators, be removable within a 3 foot maintenance clearance, without draining the tank.

Tank heaters shall be furnished with Nema 4 weatherproof terminal boxes Chromalox model 16-122571 (or approved equal).

#### 2.18 WATER STORAGE TANK HEATER CONTROL PANEL

- a. Tank heater control system shall be custom designed to support the functions of temperature control, overtemperature control, low water protection as indicated, but not limited to below:
- b. Tank heater control panel shall be a U.L. listed digital indicating temperature and overtemperature controller, NEMA 12 enclosure. Control panel shall be completely factory wired, including main disconnect switch.
- c. Tank heater control panel shall be as manufactured by Chromalox (or approved equal); Chromalox model 4472-60660.
- d. Tank heater control panel shall include model 2104 1/4 DIN single loop temperature controller (with alarm contact and dual outputs), time out heater failure feature, hi limit control, control power transformer, and separate heater contactors.
- e. Tank Water temperature controller sensor and Water temperature high limit sensor shall be type J Spring loaded weatherproof thermocouples as manufactured by Chromalox (or approved equal); Chromalox model JS2AU12"NB7 with 3/4" NPT A260U10.5-304 stainless steel thermowells.
- f. Tank heater control loop shall include flanged chamber type low and high water level controls incorporating Mercoid model 102wt-4915-c-60 cast iron float chambers. All components of the assembly to be serviceable without draining the tank. Housing shall be weatherproof, and include flanged inspection plate as well as valved inlet for isolating the assembly from the tank.
- g. Coordinate all required openings with tank manufacturer(Section 13206 Steel Standpipes and Ground Storage Reservoirs)..Pay costs of any additional openings required in the tank.

Provide all control and power wiring and devices, other than shown in division 16.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION CRITERIA

The HVAC control system shall be installed and ready for operation, as specified and shown. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

##### 3.1.1 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with all required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

##### 3.1.2 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and HVAC control panels. Cables and conductors shall be tagged at both ends, with the identifier shown on the shop drawings, in accordance with the requirements of Division 16.

###### 3.1.2.1 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from powerline surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

###### 3.1.2.2 Surge Protection for Transmitter and Control Wiring

HVAC system control panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

- a. A 10-microsecond by 1000-microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8-microsecond by 20-microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

###### 3.1.2.3 Controller Output Loop Impedance Limitation

Controller output loops shall be constructed so that total circuit impedance connected to the analog output of a single-loop controller shall not exceed 600 ohms.

#### 3.2 CONTROL SYSTEM INSTALLATION

##### 3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators

operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

### 3.2.2 Local Gauges for Actuators

Pneumatic actuators shall have an accessible and visible receiver gauge installed in the tubing lines at the actuator as shown.

### 3.2.3 Room-Instrument Mounting

Room instruments shall be mounted so that their sensing elements are 5 feet above the finished floor unless otherwise shown. Temperature setpoint device shall be recess mounted.

### 3.2.4 Smoke Detectors

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A.

### 3.2.5 Manual Emergency Fan Shutdown Switches

Manual emergency fan shutdown switches shall be provided for air distribution fans in accordance with NFPA 90A. Switches shall be the manual-reset type. Switches shall be located and mounted in an accessible manner, approximately 48 inches above the finished floor. Switches shall be properly identified in etched rigid plastic placards.

### 3.2.6 Low-Temperature-Protection Thermostats

For each 20 square feet of coil-face area, or fraction thereof, a thermostat shall be provided to sense the temperature at the location shown. The thermostat sensing element shall be installed in a serpentine pattern.

### 3.2.7 Averaging-Temperature Sensing Elements

Sensing elements shall have a total-element minimum length equal to one linear foot per square foot of duct cross-sectional area.

### 3.2.8 Foundations and Housekeeping Pads

Foundations and housekeeping pads shall be provided for the HVAC control system air compressors.

### 3.2.9 Compressed-Air Stations

The air-compressor assembly shall be mounted on vibration eliminators, in accordance with ASME BPV VIII Div 1 for tank clearance. The air line shall be connected to the tank with a flexible pipe connector. Compressed-air-station specialties shall be installed with all required tubing, including condensate tubing to a floor drain.

### 3.2.10 NOT USED

### 3.2.11 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

### 3.2.12 Control System Tubing

The control system shall be installed so that pneumatic lines are not exposed to outside-air temperatures. Air lines shall be concealed except in mechanical rooms and other areas where other tubing and piping is exposed. All tubes and tube bundles exposed to view shall be installed neatly in lines parallel to the lines of the building. Tubing between panels and actuators in mechanical/electrical spaces shall be routed so that the lines are easily traceable. Air lines shall be tested periodically for leaks during installation. Air lines shall be purged of dirt, impurities and moisture before connecting to the control equipment. Air lines shall be number coded or color coded and keyed to the submittal drawings for future identification and servicing the control system.

#### 3.2.12.1 Pneumatic Lines

In mechanical/electrical spaces, pneumatic lines shall be copper tubing. Horizontal and vertical runs of soft copper tubes shall be installed in raceways dedicated to tubing. The dedicated raceways shall be supported every 6 feet for horizontal runs and every 8 feet for vertical runs. Tubing not installed in raceways shall be hard-drawn copper tubing with sweat fittings and valves, supported every 6 feet for horizontal runs and every 8 feet for vertical runs.

#### 3.2.12.2 Pneumatic Lines External To Mechanical/Electrical Spaces

Tubing external to mechanical/electrical spaces, when run in plenum ceilings, shall be soft copper with sweat fittings, supported every 8 feet. Tubing not in plenum spaces shall be soft copper with sweat fittings supported every 8 feet or shall be plastic tubing in raceways dedicated to tubing.

#### 3.2.12.3 Connection to Liquid and Steam Lines

Tubing for connection of sensing elements and transmitters to liquid and steam lines shall be copper with brass compression fittings.

#### 3.2.12.4 Connection to Ductwork

Tubing for connection of sensing elements and transmitters to ductwork shall be plastic tubing.

#### 3.2.12.5 Tubing in Concrete

Tubing in concrete shall be installed in rigid conduit. Tubing in walls containing insulation, fill, or other packing materials shall be installed in raceways dedicated to tubing.

#### 3.2.12.6 Final Connection to Actuators

Final connections to actuators shall be plastic tubing 12 inches long and unsupported at the actuator.

#### 3.2.12.7 Connection to HVAC Control Panel

A manual valve shall be provided at each HVAC control panel to allow shutoff of main air. Pneumatic connections to HVAC control panels shall be made at bulkhead fittings. Final connections to HVAC control panel bulkhead fitting shall be exposed tubing approximately 12 inches long.

### 3.3 SEQUENCE OF OPERATION

#### 3.3.1 Inspection Building

##### 3.3.1.1 Electrical Hazard Rating

Exercise caution in selecting controls for bays 101, 102 and 103. The

controls in these bays shall maintain the hazard rating for class II, Division 1 and 2, groups E,F and G per the NEC. The mechanical room does not have a hazard rating, but installation shall not compromise the hazard ratings of the three bays.

#### 3.3.1.2 Pneumatic Option

At the contractors option, controls may be pneumatic for bays 101, 102 and 103. Contractor to furnish air compressor and refrigerated drier as well as all necessary control devices and power wiring for the pneumatic system, if this option is taken. A breaker suitable for 5 hp has been indicated for this purpose.

#### 3.3.1.3 Heating and Ventilation - Bays 101,102 and 103

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 75 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 68 deg F, the thermostat shall start the electric unit heater and heat until the temperature rises to 72 deg F.

#### 3.3.1.3.# Thermostat

One 24 volt hazard-rated thermostat shall provide both heating and cooling functions for each unit heater/fan combination..

#### 3.3.1.4 Heating and Ventilation - Mechanical Room

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 55 deg F, the unit mounted thermostat shall start the electric unit heater and heat until the temperature rises to 55 deg F.

#### 3.3.2 Residue Building

##### 3.3.2.1 Heating and Ventilation - Bays 101 and 102

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 75 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 68 deg F, the thermostat shall start the electric unit heater and heat until the

temperature rises to 72 deg F.

#### 3.3.2.1.# Thermostat

One 24 volt programmable thermostat shall provide both heating and cooling functions.

#### 3.3.2.2 Heating and Ventilation - Mechanical Room

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

##### Heating:

On a fall in space temperature below the setpoint of 55 deg F, the unit mounted thermostat shall start the electric unit heater and heat until the temperature rises to 55 deg F.

#### 3.3.2.3 Restroom Fan

Fans to be interlocked with light switches.

#### 3.3.2.4 Restroom Heater

On a fall in space temperature below the setpoint of 68 deg F, the unit mounted thermostat shall start the electric unit heater and heat until the temperature rises to 72 deg F.

#### 3.3.2.5 Heating and Air Conditioning - PTAC

##### Setpoints:

Occupied mode shall be initiated by programmable room thermostat. Occupied temperature shall be 75 degree F cooling; 68 deg F heating. Unoccupied temperature shall be 80 degree F cooling; 65 deg F heating.

##### Ventilation:

Outside air damper shall be enabled to open during occupied mode and remain closed during the unoccupied mode. Damper shall open only when the unit compressor runs.

##### Fan Operation:

Fan shall run continuous in occupied modes, and cycle during unoccupied modes.

##### Sequence:

PTAC controls shall be as specified; unit shall maintain temperatures indicated, and stage auxiliary heat as required to maintain setpoint.

#### 3.3.2.6 Forklift Charging Station Exhaust Fans

Sail switch shall verify flow and enable the forklift charging system(s).

### 3.3.3 Operations Building

#### 3.3.3.1 Heating and Ventilation - Mechanical Room

##### Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

Heating:

On a fall in space temperature below the setpoint of 55 deg F, the thermostat shall start the electric unit heater and heat until the temperature rises to 55 deg F.

#### 3.3.3.1.# Thermostat

One 24 volt thermostat shall provide both heating and cooling functions.

#### 3.3.3.2 Restroom Fan

Fan to be interlocked with women's room light switch.

#### 3.3.3.3 Heating and Air Conditioning - AC-1 and HP-1

Setpoints:

Occupied mode shall be initiated by programmable room thermostat. Occupied temperature shall be 75 degree F cooling; 68 deg F heating. Unoccupied temperature shall be 80 degree F cooling; 65 deg F heating.

Ventilation:

Outside air damper shall be enabled to open during occupied mode and remain closed during the unoccupied mode.

Fan Operation:

Fan shall run continuous in occupied modes, and cycle during unoccupied modes.

Sequence:

Split system controls shall be as specified; unit shall maintain temperatures indicated, and stage auxiliary heat as required to maintain setpoint. Duct smoke detector shall shut down the fan on sensing smoke. Detector shall have contacts for initiating a fire alarm.

#### 3.3.4 Pumphouse

##### 3.3.4.1 Heating and Ventilation

Ventilation:

On a rise in space temperature above the setpoint of 80 deg F, the thermostat shall allow the damper actuator to open the intake damper and start the exhaust fan. At 70 deg F, the fan shall stop and the damper will close.

Heating:

On a fall in space temperature below the setpoint of 55 deg F, the thermostat shall start the electric unit heater and heat until the temperature rises to 60 deg F.

##### 3.3.4.1.# Thermostat

One 24 volt thermostat shall provide both heating and cooling functions.

### 3.3.4.2 Tank Immersion Heater Control and Control Panel

#### 3.3.4.2 Sequence

On a fall in tank temperature sensed by the thermocouple, below the setpoint of 35 deg F, the heater controller shall start the electric tank immersion heaters and heat until the temperature rises to 45 deg F. A high limit Thermocouple shall not allow the tank temperature to rise above 55 deg F. A low water level switch shall lockout the heaters on sensing low water in the tank. Failure of any one heater shall not disable the remaining heaters. A green light shall indicate that the tank heaters are functioning. A red alarm light shall indicate a failure of the heaters to maintain temperature in the tank and sound an exterior alarm horn at 33 deg F.

### 3.3.4.3 Well Pump and Control Panel

#### 3.3.4.3.# Sequence

The well pump shall start on a drop in line pressure below setpoint of 55 psi, as sensed by a pressure switch in the pumphouse well water supply line. Pump shall stop on a rise in line pressure to 65 psi.

#### 3.3.4.3.# Responsibility

Division 16 contractor furnishes and installs a well pump motor starter, and starter power wiring.

Well pump control panel shall be furnished and installed under this section. Panel shall include all wiring and devices, including control transformers, relays and accessories to perform the desired functions.

### 3.3.4.4 Tank Fill Controls

#### 3.3.4.4.# Sequence

A mechanical spring-type altitude valve (specified in section 13206, installed under division 15) shall be set to open whenever the head pressure is such that the tank water level is below the minimum fill height. Valve shall close just prior to water reaching the height of the tank overflow. Valve shall be listed for use on the fire water system. A solenoid valve in parallel with the altitude valve shall provide redundant fill control. The solenoid valve shall open whenever the water level drops below the minimum fill height, as sensed by the upper water level switch.

#### 3.3.4.4.# Freeze Protection

Install 5 watt per foot heat tracing from fill panel to upper water level switch, to protect against freezing. Chromalox type SRL, 120 volt or equivalent cable. Install in conduit up to switch.

#### 3.3.4.4.# Fire Pump Control

A low level switch (same as specified for tank fill) in the tank shall disable the fire pump, sound an alarm and turn on an indicating light signaling low water (tank level less than 12" above tank bottom). Fire pump control shall incorporate a sequence and device to open the mechanical room intake damper to allow for combustion air from outside.

## SECTION 15990

## TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

## NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01 (1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

TAB Related HVAC Submittals; FIO.

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

## SD-04 Drawings

TAB Schematic Drawings and Report Forms; GA.

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

## SD-06 Instructions

TAB Procedures; GA.

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

## SD-07 Schedules

Systems Readiness Check; FIO.

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; GA.

Proposed date and time to begin field measurements, making adjustments,

etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; GA.

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

#### SD-08 Statements

TAB Firm; GA.

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist; GA.

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

Instrument Calibration; FIO.

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

#### SD-09 Reports

Design Review Report; GA.

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check Report; GA.

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; GA.

Three copies of the completed TAB Reports, no later than 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; GA.

Three copies of the completed TAB Verification Report, no later than 7 days after the execution of TAB Verification. All items in the TAB Verification

Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-13 Certificates

Ductwork Leak Testing; FIO.

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard Adjusting Systems.	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing Balancing of Environmental
TAB Specialist	TAB Engineer	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1or NEBB-01, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor, and shall report to and be paid by the prime Contractor.

#### 1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

#### 1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995 COMMISSIONING OF HVAC SYSTEMS.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

##### 3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

### 3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

### 3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

### 3.5 TESTING, ADJUSTING, AND BALANCING

#### 3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

#### 3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

#### 3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

#### 3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

#### 3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

#### 3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --

SECTION 16120  
INSULATED WIRE AND CABLE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

- |          |   |
|----------|---|
| AEIC CS5 | (Oct 1987; 9th Ed) Thermoplastic and Crosslinked Polyethylene Insulated Shielded Power Cables Rated 5 Through 35 kV |
| AEIC CS6 | (Oct 1987; 5th Ed; Rev Mar 1989) Ethylene Propylene Insulated Shielded Power Cables Rated 5 Through 69 kV           |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- |              |   |
|--------------|---|
| IEEE Std 383 | (1974; R 1992) Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations |
|--------------|---|

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |           |  |
|-----------|--|
| NEMA WC 7 | (1988) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy |
| NEMA WC 8 | (1988) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy               |

## 1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-01 Data

Installation Instructions; FIO.

The Contractor shall submit cable manufacturing data [as requested].

## SD-09 Reports

Tests, Inspections, and Verifications; FIO.

6 certified copies of test reports shall be submitted by the contractor.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length,

voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices.

#### 1.4 PROJECT/SITE CONDITIONS

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 NOT USED

##### 2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with Table 3-1 of NEMA WC 7 or NEMA WC 8.

##### 2.1.3 Conductors

###### 2.1.3.1 Material

Conductors shall conform to all the applicable requirements of Section 2 of NEMA WC 7 or Part 2 of NEMA WC 8 as applicable and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

###### 2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in Table 3-1 of Section 3 of NEMA WC 7 or Part 3 of NEMA WC 8, as applicable.

###### 2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix L of NEMA WC 7 or NEMA WC 8, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

###### 2.1.3.4 Conductor Shielding

Conductor shielding conforming to paragraph 2.7 of NEMA WC 7 or NEMA WC 8, as applicable, shall be used on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC CS5 or AEIC CS6. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied insulation.

###### 2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

##### 2.1.4 Insulation

#### 2.1.4.1 Insulation Material

Insulation shall be cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of Section 3 or paragraph 7.7 of NEMA WC 7 as applicable, or an ethylene-propylene rubber (EPR) type meeting the requirements of Part 3 of NEMA WC 8. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

- a. XLPE, if used, shall be tree-retardant.
- b. Insulation shall be chemically bonded to conductor shielding.
- c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC CS5 or AEIC CS6, as applicable.
- d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable [unless specifically approved].

#### 2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

- a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by Table 3-1, Section 3 of NEMA WC 7 or Table 3-1, Part 3, of NEMA WC 8, as applicable. Column "A" thickness of Table 3-1 of NEMA WC 7 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 8 ethylene-propylene rubber-insulated conductors shall have a jacket. Column "B" thickness shall apply to single-conductor cables that require a jacket and to individual conductors of multiple-conductor cables with an overall jacket.
- b. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by Table 7-32 of NEMA WC 7 or Table 7.5.1 of NEMA WC 8 as applicable.

#### 2.1.5 Jackets

All cables shall have jackets meeting the requirements of Section 4 of NEMA WC 7, or Part 4 of NEMA WC 8, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

##### 2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Variations from the

materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. General Use

- (1) Heavy-duty black neoprene (NEMA WC 8, paragraph 4.4.3).
- (2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 8, paragraph 4.4.10).
- (3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 8, paragraph 4.4.11).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

- (1) General-purpose neoprene (NEMA WC 8, paragraph 4.4.4).
- (2) Black polyethylene (NEMA WC 8, paragraph 4.4.6).
- (3) Thermoplastic chlorinated polyethylene (NEMA WC 8, paragraph 4.4.7).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by Section 4, Table 4-6 of NEMA WC 7 or Part 4, Table 4-4 of NEMA WC 8, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 4, Table 4-7, of NEMA WC 7 or Part 4, Table 4-5, of NEMA WC 8.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in Section 4, Table 4-4 of NEMA WC 7 or Part 4, Table 4-2 of NEMA WC 8. If shielded, the jacket thickness shall be in accordance with the requirements of Section 4, Table 4-5 of NEMA WC 7 or Part 4, Table 4-3 of NEMA WC 8.

2.1.6 NOT USED

2.1.7 Identification

2.1.7.1 Color-coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with paragraph 5.3 of NEMA WC 8, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with Table 5-2 of NEMA WC 8. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included.

2.1.8 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to Part 5 of NEMA WC 8, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

#### 2.1.9 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

#### 2.2 INSTALLATION INSTRUCTIONS

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

- a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.
- b. Pulling tension and sidewall pressure limits, in pounds.
- c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.
- d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

#### 2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

##### 2.3.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

##### 2.3.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with Section 6 of NEMA WC 7 or Part 6 of NEMA WC 8. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

##### 2.3.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for

cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

#### 2.3.2.2 NOT USED

#### 2.3.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE Std 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 7, paragraph 7.7.3.1.3. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

#### 2.3.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

#### 2.3.2.5 Reports

Results of tests made shall be furnished. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

### PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 16375

## ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (FOG) Apparatus
ASTM C 478	(1996) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1996) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Electrical Equipment
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE Std 48(1996)	Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81(1983)	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

IEEE Std 100(1996) IEEE Standard Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1 (1993) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies

NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 467 (1993; Rev thru Aug 1996) Grounding and Bonding Equipment

UL 486A (1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486B (1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors

UL 510 (1994; Rev thru Nov 1997) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

UL 514A (1996) Metallic Outlet Boxes

UL 651 (1995; Rev thru Apr 1997) Schedule 40 and 80 Rigid PVC Conduit

UL 1242 (1996; Rev Apr 1997) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.3 SUBMITTALS

Governmental approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Catalog Data; GA.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

#### SD-04 Drawings

Electrical Distribution System; GA.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

- a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
- b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

As-Built Drawings; GA.

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

#### SD-09 Reports

#### Factory Test; GA.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

#### SD-13 Certificates

#### Materials and Equipment; GA.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

### 1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer

regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

## 2.2 NAMEPLATES

### 2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal.

## 2.3 CORROSION PROTECTION

### 2.3.1 NOT USED

### 2.3.2 Ferrous Metal Materials

#### 2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

#### 2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

### 2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

## 2.4 CABLES

### 2.4.1 NOT USED

### 2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

#### 2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

#### 2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

#### 2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

#### 2.4.2.4 NOT USED

#### 2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

### 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

#### 2.5.1 NOT USED

#### 2.5.2 NOT USED

#### 2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B.

Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

#### 2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

##### 2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level.

##### 2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 25 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

## 2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type or nonencased direct-burial, thick-wall type as shown on drawing.

### 2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

### 2.6.2 Nonmetallic Ducts

#### 2.6.2.1 NOT USED

#### 2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

#### 2.6.2.3 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 Type DB.

### 2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

## 2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

### 2.8 NOT USED

### 2.9 NOT USED

### 2.10 NOT USED

### 2.11 NOT USED

### 2.12 NOT USED

### 2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

#### 2.14 NOT USED

#### 2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

##### 2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

##### 2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

##### 2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

##### 3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

##### 3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or

set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc.

### 3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

#### 3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

#### 3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

#### 3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

#### 3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

#### 3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.

- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

### 3.2.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

### 3.2.3 NOT USED

#### 3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

#### 3.2.3.2 NOT USED

#### 3.2.3.3 Other Requirements

Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

#### 3.2.3.4 Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

#### 3.2.3.5 Cable Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. In addition to markers, a 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

### 3.2.4 NOT USED

### 3.2.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

### 3.3 NOT USED

### 3.4 NOT USED

### 3.5 DUCT LINES

#### 3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

#### 3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

#### 3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is

required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

#### 3.5.4 Nonencased Direct-Burial

Duct lines shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

#### 3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

##### 3.5.5.1 NOT USED

##### 3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

#### 3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

### 3.6 MANHOLES, HANDHOLES, AND PULLBOXES

#### 3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved

areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

### 3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

### 3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

### 3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

### 3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

### 3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 2/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

## 3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation,

surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

### 3.7.1 Concrete Pads

#### 3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

#### 3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

#### 3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

### 3.8 NOT USED

### 3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

### 3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, to the ground ring. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

#### 3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.
- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 12 inches, plus or minus 3 inches, below finished top of soil grade. Ground ring conductors shall be #2/0 AWG.
- d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three, 10 foot rods spaced a minimum of 10 feet apart, coupled and driven with the first rod. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

### 3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

### 3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

### 3.10.4 NOT USED

### 3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

## 3.11 FIELD TESTING

### 3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor,

and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

### 3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

### 3.11.3 Ground-Resistance Tests

The resistance of the ground ring or electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Ground ring - 10 ohms.

### 3.11.4 NOT USED

### 3.11.5 NOT USED

### 3.11.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$R$  in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

### 3.11.7 NOT USED

### 3.11.8 NOT USED

### 3.11.9 NOT USED

### 3.11.10 NOT USED

### 3.11.11 NOT USED

### 3.11.12 NOT USED

### 3.11.13 Operating Tests

After the installation is completed, and at such times as the Contracting

Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

### 3.12 MANUFACTURER'S FIELD SERVICE

#### 3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

#### 3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

### 3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

## SECTION 16403

## MOTOR CONTROL CENTERS, SWITCHBOARDS AND PANELBOARDS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B 187 (1994) Copper Bar, Bus Bar, Rod and Shapes  
ASTM B 317 (1992a) Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Shapes for Electrical Purposes (Bus Conductor)

## ASME INTERNATIONAL (ASME)

- ASME B1.1 (1989) Unified Inch Screw Threads (UN and UNR Thread Form)  
ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA AB 1 (1993) Molded Case Circuit Breakers and Molded Case Switches  
NEMA PB 1 (1990) Panelboards

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (1993) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

- UL 44 (1991; Rev thru Jan 1995) Rubber-Insulated Wires and Cables  
UL 50 (1992) Enclosures for Electrical Equipment  
UL 67 (1993; Rev thru May 1994) Panelboards  
UL 489 (1991; Rev thru Dec 1994) Molded Case Circuit Breakers and Circuit Breaker Enclosures  
UL 1063 (1993; Rev thru Oct 1994) Machine-Tool Wires and Cables

## 1.2 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

## 1.2.1 Rules

The equipment shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. The contractor shall immediately notify the Contracting Officer of any requirements of the specifications or contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

#### 1.2.2 Coordination

The general arrangement of the motor control centers, switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Contracting Officer. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory. The motor control centers and switchboards may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

#### 1.2.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the Contracting Officer, complete specifications for the materials which he proposes to use.

#### 1.2.4 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum approximately 4 millimeters (1/8 inch) thick, engraved to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 15 millimeters (1/2 inch) high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

- a. Panelboards
- b. Individually-mounted circuit breakers in Panelboard

Equipment of the withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation. Equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection. Submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA.

The Contractor shall within 30 calendar days after date of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Six (6) sets of characteristic curves of the individual breaker trip element shall be submitted.

#### SD-04 Drawings

Outline Drawings; GA.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

Panelboards; GA.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each switchboard and panelboard.

#### SD-08 Statements

Factory Tests; FIO.

The Contractor shall submit, within a minimum of 14 days prior to the proposed date of tests, six (6) copies of manufacturer's routine factory test procedures and production line tests for all motor control centers and switchboards.

#### SD-09 Reports

Factory Tests; FIO.

The Contractor shall submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Report shall be signed and dated by the Contractor's and Contracting Officer's Representatives.

### 1.4 DELIVERY, STORAGE, AND HANDLING

The equipment shall be shipped as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during

shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck.

## 1.5 MAINTENANCE

### 1.5.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus shall be furnished by the Contractor.

## PART 2 PRODUCTS

### 2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Contracting Officer, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

### 2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

#### 2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

#### 2.2.2 NOT USED

#### 2.2.3 120/240-Volt AC Circuits

Circuit breakers for 120-volt ac circuits shall be rated not less than 120/240 or 240 volts ac, and shall have a UL listed minimum interrupting capacity of 10,000 symmetrical amperes.

### 2.3 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW

meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings. Panelboards shall be fully rated for a short-circuit current of 22,000 symmetrical amperes RMS ac.

2.8.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than 3.5 millimeters (No. 10 gage) if flush-mounted or mounted outdoors, and not less than 2.7 millimeters (No. 12 gage) if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Outdoor cabinets shall be of NEMA 3R raintight and a removable steel plate 7 millimeters (1/4 inch) thick in the bottom for field drilling for conduit connections. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 3 millimeters (1/8 inch). Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 15 millimeter (1/2 inch) clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 600 millimeters (24 inches) long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph NAMEPLATES. Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

2.8.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper and shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187, and ASTM B 317. The sizes of buses

and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

### 2.8.3 Components

Each branch circuit, and the main buses where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Circuit breakers of the same frame size and rating shall be interchangeable.

### 2.9 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Grey. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph SPARE PARTS.

### 2.10 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Contracting Officer unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Contracting Officer to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Contracting Officer. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Contracting Officer. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

#### 2.10.1 NOT USED

#### 2.10.2 NOT USED

#### 2.10.3 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

### PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 16415

## ELECTRICAL WORK, INTERIOR

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C39.1 (1981; R 1992) Requirements for Electrical Analog Indicating Instruments
- ANSI C82.4 (1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B 1 (1995) Hard-Drawn Copper Wire
- ASTM B 8 (1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D 709 (1992; R 1997) Laminated Thermosetting Materials

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE ANSI/IEEE C57.13 (1993) Instrument Transformers
- IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA FU 1 (1986) Low Voltage Cartridge Fuses
- NEMA ICS 1 (1993) Industrial Control and Systems
- NEMA ICS 2 (1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
- NEMA ICS 3 (1993) Industrial Control and Systems Factory Built Assemblies
- NEMA ICS 6 (1993) Industrial Control and Systems Enclosures
- NEMA LE 4 (1987) Recessed Luminaires, Ceiling Compatibility

NEMA OS 1 (1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA OS 2 (1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

NEMA RN 1 (1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NEMA WD 1 (1983; R 1989) General Requirements for Wiring Devices

NEMA WD 6 (1988) Wiring Devices - Dimensional Requirements

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

NFPA 101 (1997; Errata 97-1) Life Safety Code

## UNDERWRITERS LABORATORIES (UL)

UL 1 (1993; Rev thru Jan 1995) Flexible Metal Conduit

UL 6 (1997) Rigid Metal Conduit

UL 50 (1995; Rev thru Oct 1997) Enclosures for Electrical Equipment

UL 83 (1996; Rev Sep 1997) Thermoplastic-Insulated Wires and Cables

UL 98 (1994; R thru Oct 1995) Enclosed and Dead-Front Switches

UL 198E (1988; Rev Jul 1988) Class R Fuses

UL 360 (1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit

UL 467 (1993; Rev thru Aug 1996) Grounding and Bonding Equipment

UL 486A (1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486C (1997) Splicing Wire Connectors

UL 498 (1996; Rev thru Nov 1997) Attachment Plugs and Receptacles

UL 508 (1993; Rev thru Oct 1997) Industrial Control Equipment

UL 510 (1994; Rev thru Nov 1997) Insulating Tape

UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1996) Metallic Outlet Boxes
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 514C	(1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994; Rev May 1997) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995; Rev thru Apr 1997) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev Sep 1996) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 698	(1995; Rev thru Dec 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 869A	(1993; Rev thru Apr 1996) Reference Standard for Service Equipment
UL 886	(1994; Rev thru Jan 1997) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 943	(1993; Rev thru Mar 1997) Ground-Fault Circuit-Interrupters
UL 1010	(1995; Rev thru Dec 1996) Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1029	(1994; Rev thru Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1242	(1996; Rev Apr 1997) Intermediate Metal Conduit
UL 1570	(1995; Rev thru Jun 1997) Fluorescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 97) High Intensity Discharge Lighting Fixtures
UL 1660	(1994; Rev Jan 1996) Liquid-Tight Flexible Nonmetallic Conduit
UL Elec Const Dir	(1997) Electrical Construction Equipment Directory

## 1.2 GENERAL

### 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

### 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible.

Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

### 1.2.3 Special Environments

#### 1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

#### 1.2.3.2 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70 for Class II, Division 1 and 2 hazardous locations. Equipment shall be suitable for Group E, F, and G.

#### 1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

### 1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 1.2.5 NAMEPLATES

#### 1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an

irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Starters	Control Power Transformers
Safety Switches	Control Devices
Equipment Enclosures	Instrument Transformers
Motors	

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Catalog; GA.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

SD-04 Drawings

Interior Electrical Equipment; GA.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional

items shall be clearly identified as included or excluded.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings; GA.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-08 Statements

Onsite Test; GA.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-09 Reports

Factory Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; GA.

A detailed description of the Contractor's proposed procedures for onsite test submitted 20 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

#### 1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

#### PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

##### 2.1 NOT USED

##### 2.2 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

##### 2.2.1 NOT USED

##### 2.2.2 NOT USED

##### 2.2.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

#### 2.2.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

#### 2.6 CIRCUIT BREAKERS

2.6.1 NOT USED

2.6.2 NOT USED

2.6.3 NOT USED

2.6.4 NOT USED

#### 2.6.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.6.6 NOT USED

2.6.7 NOT USED

#### 2.6.8 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.7 NOT USED

#### 2.8 CONDUIT AND TUBING

##### 2.8.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.8.2 NOT USED

##### 2.8.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

##### 2.8.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

##### 2.8.5 Intermediate Metal Conduit

UL 1242.

2.8.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.8.7 NOT USED

2.8.8 Rigid Metal Conduit

UL 6.

2.8.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.9 CONDUIT AND DEVICE BOXES AND FITTINGS

2.9.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514C.

2.9.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.9.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.9.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.9.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.9.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.9.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.10 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.11 CONNECTORS, WIRE PRESSURE

2.11.1 For Use With Copper Conductors

UL 486A.

2.12 NOT USED

2.13 ENCLOSURES

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

2.13.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.14 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.14.1 Fixture, Auxiliary or Emergency

UL 924.

2.14.2 NOT USED

2.14.3 Fluorescent

- a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

- b. Ballasts:

(1) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS\*

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
32W F32 T8	rapid or instant start	120 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

- c. Lampholders, Starters, and Starter Holders: UL 542.

2.14.4 High-Intensity-Discharge

- a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

- b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.15 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.15.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.15.2 NOT USED

2.15.3 NOT USED

2.15.4 NOT USED

## 2.15.5 Fuses, Class R

UL 198E.

## 2.15.6 NOT USED

## 2.15.7 NOT USED

## 2.15.8 NOT USED

## 2.15.9 Fuseholders

UL 512.

## 2.16 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

## 2.17 NOT USED

## 2.18 MOTOR CONTROLS

## 2.18.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

## 2.18.2 Motor Starters

Combination starters shall be provided as indicated.

## 2.18.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 25 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generated sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

## 2.18.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

## 2.18.4 Low-Voltage Motor Overload Relays

## 2.18.4.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the

requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds. Quick trip units shall be used on hermetically sealed, submersible pumps, and similar motors.

#### 2.18.4.2 Construction

Manual reset type thermal relay shall be melting alloy or bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

#### 2.18.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

#### 2.18.5 Automatic Control Devices

##### 2.18.5.1 NOT USED

##### 2.18.5.2 NOT USED

##### 2.18.5.3 Manual/Automatic Selection

- a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.
- b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.
- c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls voltages shall be coordinated with mechanical systems.

##### 2.19 NOT USED

#### 2.20 RECEPTACLES

##### 2.20.1 NOT USED

##### 2.20.2 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

## 2.20.3 Standard Grade

UL 498.

## 2.20.4 Ground Fault Interrupters

UL 943, Class A or B.

## 2.20.5 Hazardous (Classified) Locations

UL 1010.

## 2.20.6 NEMA Standard Receptacle Configurations

NEMA WD 6.

## a. Single and Duplex, 20-Ampere, 125 Volt

20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

## b. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

## c. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

## d. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

## e. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

## f. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

## 2.21 Service Entrance Equipment

UL 869A.

## 2.22 SPLICE, CONDUCTOR

UL 486C.

## 2.23 NOT USED

## 2.24 NOT USED

## 2.25 TAPES

## 2.25.1 Plastic Tape

UL 510.

#### 2.25.2 Rubber Tape

UL 510.

2.26 NOT USED

2.27 NOT USED

2.28 NOT USED

2.29 NOT USED

2.30 NOT USED

#### 2.31 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

### PART 3 EXECUTION

#### 3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

##### 3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 10 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

##### 3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

##### 3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment

grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

### 3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, and intermediate metal conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

#### 3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07270 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

##### 3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be

left at each end of the pull wire.

#### 3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

#### 3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

#### 3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

#### 3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

#### 3.2.1.6 Supports

Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways

shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

#### 3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

#### 3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

#### 3.2.1.9 NOT USED

#### 3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 Cables and Conductors

##### 3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

##### 3.2.4.2 NOT USED

##### 3.2.4.3 NOT USED

##### 3.2.4.4 NOT USED

##### 3.2.4.5 NOT USED

### 3.2.4.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made.

Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

- a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).

- b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.
- c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

### 3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

#### 3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes

may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

### 3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

### 3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

### 3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

## 3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be satin finish

corrosion resistant steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

### 3.5 RECEPTACLES

#### 3.5.1 Single and Duplex, 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

#### 3.5.2 NOT USED

#### 3.5.3 NOT USED

#### 3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

##### 3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

##### 3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

#### 3.5.5 NOT USED

#### 3.5.6 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with

appropriate mating cord-grip plug.

### 3.5.7 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, four-wire, grounding type, complete with appropriate mating cord-grip type attachment plug.

### 3.5.8 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

### 3.5.9 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, four-wire, grounding type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range.

### 3.5.10 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

### 3.5.11 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

## 3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120 or 277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

### 3.7 NOT USED

### 3.8 NOT USED

## 3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and

shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as shown or specified.

3.9.1 NOT USED

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 shall have tested interrupting capacity not less than 100,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.4 NOT USED

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 NOT USED

3.12 NOT USED

3.13 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual

control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.13.1 NOT USED

3.13.2 NOT USED

3.13.3 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.14 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.15 NOT USED

3.16 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.16.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.16.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.16.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall be as indicated and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.16.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be as shown.

3.16.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

#### 3.16.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

#### 3.16.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

#### 3.16.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

#### 3.16.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

#### 3.16.3 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

#### 3.17 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

#### 3.18 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the

specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

### 3.18.1 Motors and Motor Control

Motor controls shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motor controls, and terminated.

### 3.19 NOT USED

### 3.20 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

### 3.21 NOT USED

### 3.22 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

#### 3.22.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.22.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.
- b. Grounding electrode system - 10 ohms.

#### 3.22.3 Ground-System Connection Inspection

All below-grade ground-system connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 7 hours before the site is ready for inspection.

#### 3.22.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

$R$  in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

##### 3.22.4.1 NOT USED

##### 3.22.4.2 Low Voltage Cable Tests

- a. Continuity test.
- b. Insulation resistance test.

##### 3.22.5 NOT USED

##### 3.22.6 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.
- c. High potential test on each winding to ground.
- d. Insulation resistance of each winding to ground.
- e. Vibration test.
- f. Dielectric absorption test on motor [and starter].

##### 3.22.7 NOT USED

##### 3.22.8 NOT USED

##### 3.22.9 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

##### 3.22.9.1 NOT USED

##### 3.22.9.2 NOT USED

##### 3.22.9.3 Circuit Breakers, Molded Case

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test.
- d. Manual operation of the breaker.

##### 3.22.10 NOT USED

### 3.22.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE ANSI/IEEE C57.13.

### 3.23 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

### 3.24 NOT USED

### 3.25 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

## SECTION 16528

## EXTERIOR LIGHTING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO LTS-3 (1994) Standard Specifications for  
Structural Supports for Highway Signs,  
Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1375 (1990; R 1996) 400-Watt, M59 Single-Ended  
Metal-Halide Lamps

ANSI C78.1376 (1990; R 1996) 1000-Watt, M47 Metal-Halide  
Lamps

ANSI C82.4 (1992) Ballasts for  
High-Intensity-Discharge and Low-Pressure  
Sodium Lamps (Multiple-Supply Type)

ANSI C136.2 (1985) Luminaires, Voltage Classification  
of

ANSI C136.3 (1989) Luminaire Attachments - for Roadway  
Lighting Equipment

ANSI C136.6 (1990) Roadway Lighting Equipment - Metal  
Heads and Reflector Assemblies -  
Mechanical and Optical Interchangeability

ANSI C136.9 (1990) Roadway Lighting Equipment - Socket  
Support Assemblies for Use in Metal Heads  
- Mechanical Interchangeability

ANSI C136.10 (1995) Locking-type Photocontrol Devices  
and Mating Receptacles - Physical and  
Electrical Interchangeability and Testing  
for Roadway Lighting Equipment

ANSI C136.11 (1988; R 1994) Multiple Sockets for  
Roadway Lighting Equipment

ANSI C136.15 (1986) High-Intensity-Discharge and  
Low-Pressure Sodium Lamps in Luminaires -  
Field Identification

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings  
on Iron and Steel Products

ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 117	(1995) Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

## ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE ANSI/IEEE C136.13	(1987; R 1997) Metal Brackets for Wood Poles

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata) National Electrical Code
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## UNDERWRITERS LABORATORIES (UL)

UL 98	(1994; Rev Oct 1995) Enclosed and Dead-Front Switches
UL 1029	(1994; Rev Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1571	(1991; Rev thru Mar 1995) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures

## 1.2 SYSTEM DESCRIPTION

## 1.2.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

## 1.2.2 NOT USED

## 1.2.3 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.2.4 NOT USED

1.2.5 NOT USED

1.2.6 NOT USED

1.2.7 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.2.8 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.2.9 NOT USED

1.2.10 NOT USED

1.2.11 Protection of Security Lighting System Components

1.2.11.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways or by means of direct burial, as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaires mounted below 20 feet. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

1.3 CORROSION PROTECTION

1.3.1 NOT USED

1.3.2 Ferrous Metal Materials

1.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

1.3.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to

the manufacturer's standard.

### 1.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Equipment and Materials; GA.

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

#### SD-04 Drawings

Lighting System; GA.

Detail drawings for the complete system and for poles, lighting fixtures, and bracket arms.

- a. Lamp strike and restrike times.
- b. A typical zone layout showing light locations, isolux patterns, point by points, and lighting ratios.

As-Built Drawings; GA.

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

#### SD-09 Reports

Operating Test; GA.

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

### 2.2 BRACKET ARMS

#### 2.2.1 On Steel Poles

Poles shall be provided with bracket arms of the support arm style and of

the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE ANSI/IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 POLES

Metal poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of 80 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.11.1 NOT USED

2.11.2 Steel Poles

Steel poles shall be hot-dip galvanized in accordance with ASTM A 123 and shall not be painted. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor bolt-mounted type.

2.11.3 NOT USED

2.11.4 NOT USED

2.11.5 NOT USED

2.11.6 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.12 NOT USED

2.13 NOT USED

## 2.14 ELECTRICAL ENCLOSURES

The Contractor shall provide metallic enclosures as needed to house the lighting equipment. Enclosures shall conform to NEMA ICS 6 and NEMA 250. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer. The enclosures shall be as specified or as shown on the drawings.

### 2.14.1 Interior Enclosures

Enclosures to house lighting equipment in an interior environment shall meet the requirements of a NEMA 12 enclosure as defined in NEMA 250.

### 2.14.2 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

### 2.14.3 NOT USED

### 2.14.4 Hazardous Environment Enclosures

Equipment installed in a hazardous environment shall be installed as described in paragraph Hazardous Locations.

## 2.15 ILLUMINATION

### 2.15.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area lighting shall be in accordance with the details.

## 2.16 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

### 2.16.1 NOT USED

### 2.16.2 NOT USED

### 2.16.3 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4 or UL 1029.

### 2.17 NOT USED

### 2.18 NOT USED

## 2.19 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

## 2.20 LIGHTING CONTROL EQUIPMENT

Furnish and install a complete lighting control system. System shall include 6, Class 2, 20 amp single pole and 6 Class 2, 20 amp double pole contactors. Exact quantities and equipment configuration as shown on plans.

### 2.20.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control

element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 0.5 to 5.0 foot-candles. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

#### 2.20.2 Timer Control Switches

Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between 2030 hours and 0230 hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise shall be provided. A switch rated 120 volts, having automatically wound spring mechanism to maintain accurate time for a minimum of 7 hours following a power failure shall be provided. A time switch with a manual on-off bypass switch shall be provided. Housing for the time switch shall be a surface mounted, NEMA 1 (indoor) enclosure conforming to NEMA ICS 6.

#### 2.20.3 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

#### 2.20.4 Relays

##### 2.20.4.1 Class 2 Lighting Relays

The Class 2 lighting relays control either 120 or 208 Vac circuits loaded to a maximum of 20 amps. When required, the relays in addition to the Class 2 switching leads, will be equipped with a set of N.O. auxiliary contacts which work in tandem with the high voltage contacts and be used as mechanisms for status feed back or pilot light indicators. Each Class 2 relay may be either a combination Class 2 transformer and magnetic latching relay or split coil latching relay powered from a central transformer. Electrically held relays are not acceptable.

##### 2.20.4.2 [Enter Appropriate Subpart Title Here]

The Class 2 relays are to be mounted in a NEMA enclosure with a factory pre-wired terminal strip or factory remote mounted in minimum 4" x 4" junction box that is accessible. Manufacturer to provide all interface modules (IFM) pilot light transformers (PLPS) pre-wired as required to provide a complete operating system.

##### 2.20.4.3 [Enter Appropriate Subpart Title Here]

Control system shall interface with time clock via dry contact closure. Relays to be remote mounted inside j-box or enclosure located inside pole base. Number of circuits as shown on plans.

#### 2.20.5 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 208 volts, single, 60 Hz. Coil voltage shall be 208 volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

## 2.21 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

## 2.22 LUMINAIRES, FLOODLIGHTING

### 2.22.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572. Incandescent lighting fixtures shall conform to UL 1571.

## 2.23 FIXTURES

Standard fixtures shall be as detailed. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

### 2.23.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

### 2.23.2 NOT USED

### 2.23.3 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated at 30 amperes, 600 volts, with insulated boots. Fuse rating shall be 600 volts.

## PART 3 EXECUTION

### 3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

### 3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

### 3.3 PREVENTION OF CORROSION

#### 3.3.1 NOT USED

#### 3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 0.010 inch thick

pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

### 3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 NOT USED

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 NOT USED

3.10 NOT USED

### 3.11 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of 30 feet. Luminaire mounting height may be increased by the height of the transformer base where required. Electrical cabling shall be provided to the light pole. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

#### 3.11.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. When security lights are used along roadways, brackets shall correctly position roadway luminaires. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

#### 3.11.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 3000 psi at 28 days.

#### 3.11.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided at all poles. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 10 feet above grade. Rigid steel conduit ells shall be provided for wood poles, where required

3.11.4 NOT USED

### 3.11.5 Steel Pole Installation

Poles shall be mounted on cast-in-place or power-installed screw foundations. Conduit elbows shall be provided for cable entrances into pole interiors.

### 3.12 LIGHTING

#### 3.12.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

#### 3.12.2 Fixture Installation

##### 3.12.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

##### 3.12.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

### 3.13 NOT USED

### 3.14 LIGHTING CONTROL SYSTEM

#### 3.14.1 Photo-Control

Lighting luminaires shall be controlled in banks by a single photo-control element mounted within each bank.

#### 3.14.2 Time Control Switches

Switches shall be installed with not less than four 1/4 inch bolts. The use of sheet metal screws will not be allowed.

#### 3.14.3 NOT USED

#### 3.14.4 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws will not be allowed.

### 3.15 NOT USED

### 3.16 TESTS

#### 3.16.1 NOT USED

#### 3.16.2 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

-- End of Section --

SECTION 16710  
PREMISES DISTRIBUTION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA-568-B	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607	(1994) Commercial Building Grounding and Bonding Requirements for Telecommunications
EIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems

IBM PUBLICATION CORPORATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
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INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata) National Electrical Code
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UNDERWRITERS LABORATORY (UL)

UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment
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## 1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

## 1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

## 1.4 QUALIFICATIONS

## 1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

- a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.
- b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.
- c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

#### 1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Premises Distribution System; GA.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Record Drawings; GA.

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

##### SD-06 Instructions

Manufacturer's Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material

being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

#### SD-08 Statements

Test Plan; GA.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; GA.

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

#### SD-18 Records

Record Keeping and Documentation; GA.

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606.

### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

### 1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

### 2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

#### 2.2.1 Cable Insulation

For each individual Category 5 cable, the insulation, material used on each pair shall be exactly the same in all physical, electrical, and chemical respects. The use of Teflon insulated, plenum rated Category 5 cable is acceptable for both plenum and non-plenum applications. If Teflon insulated plenum rated cable is used by the Contractor, it shall be Type 4x0, where all four pairs are Teflon insulated. Type 3x1 and 2x2 are not acceptable.

#### 2.2.2 Riser Cable

Riser cable shall meet the requirements of ICEA S-80-576 and EIA ANSI/TIA/EIA-568-B for Category 5 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG.

#### 2.2.3 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B for Category 5 horizontal cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG.

#### 2.2.4 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with and EIA ANSI/TIA/EIA-568-B.

##### 2.2.4.1 Telecommunications Outlets

Wall and desk outlet plates shall come equipped with two RJ-45 jacks, with the top or left jack labeled "voice" and the bottom or right jack labeled "data". Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-A. Modular jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-A. Faceplates shall be provided and shall be stainless steel. Mounting plates shall be provided for system furniture and shall match the system furniture in color.

##### 2.2.4.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on 19 inch rack mounted or wall mounted panels. Jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-A. Panels shall be provided with labeling space.

##### 2.2.4.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring per EIA ANSI/TIA/EIA-568-B. Patch cords shall be factory assembled.

##### 2.2.4.4 Terminal Blocks

Terminal blocks shall be wall mounted or rack mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA ANSI/TIA/EIA-568-B for category 5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.3 NOT USED

2.4 NOT USED

## 2.5 NOT USED

## 2.6 EQUIPMENT RACKS

### 2.6.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be welded steel relay racks with uprights to mount equipment 19 inches wide. Uprights shall be 3 inch deep channel, 1-1/4 inches wide, drilled and tapped 12-24 in a 1/2 inch pattern.

Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 7 feet in height and clear coated. AC outlets shall be provided as shown.

### 2.6.2 Wall Mounted Open Frame

Wall mounted open frame equipment racks shall be steel relay racks to mount equipment 19 inches wide with standoff brackets for wall mounting.

Uprights shall be drilled and tapped 12-24 in a 1/2 inch pattern. Standoff brackets shall be of sufficient length for a 6 inch clearance between rack and wall. Wall mounted open frame racks shall be hinged. AC outlets shall be provided as shown.

### 2.6.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

### 2.6.4 NOT USED

### 2.6.5 Wall Mounted Cabinets

Wall mounted cabinets shall conform to UL 50 and have boxes constructed of zinc-coated sheet steel with dimensions not less than shown on drawings. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum openings to the box interiors. Boxes shall be provided with 3/4 inch plywood backboard painted white or a light color. A duplex AC outlet shall be installed within the cabinet.

## 2.7 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored paint.

## 2.8 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Provide a minimum 1 inch conduit.

## PART 3 EXECUTION

### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07270 FIRESTOPPING. Conduits, outlets and raceways shall be installed in

accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-B and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

### 3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Copper cable not in a wireway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

### 3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

### 3.1.3 Telecommunications Outlets

#### 3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

#### 3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 6 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

#### 3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

### 3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

### 3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

### 3.1.6 NOT USED

### 3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

### 3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

## 3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

### 3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

## 3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607 and Section 16415 ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

## 3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 10 of each type outlet.
- b. 10 of each type cover plate.
- c. 1 of each type terminal block for each telecommunications closet.
- d. 4 Patch cords of 10 feet for each telecommunications closet.
- e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

## 3.5 ADMINISTRATION AND LABELING

### 3.5.1 Labeling

### 3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606.

### 3.5.1.2 Cable

All cables will be labeled using color labels on both ends with [encoded] [unencoded] identifiers per EIA ANSI/TIA/EIA-606.

### 3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels per EIA ANSI/TIA/EIA-606.

## 3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

### 3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

### 3.6.2 Category 5 Circuits

All category 5 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67 standard. Testing shall use the Basic Link Test procedure of EIA TSB 67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

### 3.6.3 Shielded Twisted Pair

Wiring configuration shall be tested for continuity, opens, shorts, swaps and correct pin configuration; dc resistance both pair-to-pair and wire-to-shield shall be verified. Cable lengths shall be verified. Near end crosstalk shall be tested from 772 kHz to 300 MHz. Ground potential difference between wiring closets, ground potential difference between patch panel and wall outlet, and ground path resistance shall be tested per IBM GA27-3361-07.

-- End of Section --

## SECTION 16711

## TELEPHONE SYSTEM, OUTSIDE PLANT

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.61 (1993) Gas Tube Surge Arrestors on Wire Line Telephone Circuits

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2239 (1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA-607 (1994) Commercial Building Grounding and Bonding Requirements for Telecommunications

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

## INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA ANSI/ICEA S-85-625 (1996) Airecore, Polyolefin Insulated, Copper Conductor Telecommunications Cable

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996; Errata 96-4) National Electrical Code

## RURAL UTILITIES SERVICE (RUS)

RUS Bulletin 1753F-401(PC-2) (1995) RUS Standard for Splicing Copper and Fiber Optic Cables

RUS Bulletin 1755.910 RUS Specification for Outside Plant Housings and Serving Area Interface Systems

RUS REA Bulletin 345-151 (1989) Specifications and Drawings for Conduit and Manhole Construction (Form 515c)

RUS REA Bulletin 1751F-641 (1995) Construction of Buried Plant

RUS REA Bulletin 1755I-100 (1991; Rev through Supple 11 Nov 92) List of Materials Acceptable for Use on Telephone System of REA Telephone Borrowers

RUS REA PC-4 (1976) Acceptance Tests and Measurements of Telephone Plant

RUS REA PE-33	(1985) Shield Bonding Connectors
RUS REA PE-39	(1993) REA Specification for Filled Telephone Cables
RUS REA PE-89	(1993) Filled Telephone Cables with Expanded Insulation
RUS REA TE&CM 635-03	(1988; Addenda 1 through 4) Construction of Aerial Cable Plant
RUS REA TE&CM 643-02	(1983) Underground Conduit and Manhole Design and Construction (Physical Plant)

#### UNDERWRITERS LABORATORIES (UL)

UL 497	(1995; Rev Mar 1996) Protectors for Paired Conductor Communication Circuits
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### 1.2 SYSTEM DESCRIPTION

The outside plant system shall consist of all cable, conduit, manholes, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, terminating cables, lightning and surge protection modules at the entry facility. The work consists of furnishing, installing, testing and making operational a complete outside plant system for continuous use.

### 1.3 QUALIFICATIONS

#### 1.3.1 Cable Installers

Installation shall be under the direct supervision of an individual with a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

#### 1.3.2 Cable Splicing and Termination

All cable splicers shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

#### 1.3.3 Manufacturers

The cable, equipment, and hardware provided shall be from manufacturers that have a minimum of 3 years experience in producing the types of cable, equipment, and hardware specified.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Telephone System; GA.

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, and catalog cuts. Detail drawings shall also contain complete configuration information, wiring diagrams and any other details

required to demonstrate that the cable system has been coordinated to support the transmission systems identified in the specifications and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations.

Record Drawings; GA.

Record drawings for the installed wiring system showing the actual location of all cable terminations, splices, routing, and size and type of all cables. The identifier for each termination and cable shall appear on the drawings. The drawings shall include gauge and pair or fiber count for each cable, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector block layout at the termination points after installation.

#### SD-06 Instructions

Installation; GA.

Printed copies of the manufacturer's recommendations for the material being installed, prior to installation. Installation of the item will not be allowed to proceed where installation procedures, or any part thereof, are required to be in accordance with those recommendations until the recommendations are received and approved.

#### SD-08 Statements

Acceptance Tests; GA.

Test plans defining all tests required to ensure that the system meets specified requirements. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

Cutover and Records; GA.

The cutover plan shall provide procedures and schedules for relocation of facility station numbers without interrupting service to any active location.

Qualifications; GA.

The qualifications of the manufacturer, splicer, and installation supervisor as specified.

### 1.5 DELIVERY AND STORAGE

#### 1.5.1 Cable Requirements-

All cable shall be shipped on reels. The diameter of the drum shall be large enough to prevent damage to the cable during reeling and unreeling. The reels shall be constructed to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, with sufficient length to make it available for testing. The inner end shall be fastened to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 to plus 148 degrees F, with relative humidity from 0 to 100 percent.

#### 1.5.2 Equipment

All equipment shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants, in accordance with the manufacturer's requirements.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with outside plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer.

### 2.2 CABLE

#### 2.2.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

##### 2.2.1.1 Aerial

- a. Lashed: RUS REA PE-89.
- b. Self Supporting: ICEA ANSI/ICEA S-85-625.

##### 2.2.1.2 NOT USED

##### 2.2.1.3 Underground

Cable shall be manufactured per RUS REA PE-39 or RUS REA PE-89. A 5 mil copper clad alloy steel or 5 mil copper clad stainless steel metallic shield shall be provided.

##### 2.2.1.4 Screened

Screened cable shall comply with RUS REA PE-39 or RUS REA PE-89.

### 2.3 CLOSURES

#### 2.3.1 Copper Conductor Closures

##### 2.3.1.1 Aerial Closure

The aerial closure shall be free breathing and suitable for housing straight and butt splices of non-pressurized communications cables. The closure shall be constructed with ultraviolet resistant PVC.

### 2.4 CABLE SPLICES AND ORGANIZERS

#### 2.4.1 Copper Cable Splices

All cables greater than 25 pairs shall be spliced using modular splicing connectors, which accommodate 25 pairs of conductors at a time. The correct connector size shall be used to accommodate the wire gauge of the cable to be spliced. The connectors used shall be listed in RUS REA Bulletin 1755I-100.

### 2.5 CABLE TERMINALS

#### 2.5.1 Pedestal-Type Cable Terminals

Pedestal-type cable terminals shall conform to RUS Bulletin 1755.910.

#### 2.5.2 Cross-connect Cable Terminals

Cross-connect cable terminals shall be weatherproofed for outdoor use and suitable for pole, pad, or stake mounting. The terminal shall be equipped with mounting columns and distribution rings for jumper-wire routing. The terminal shall be of aluminum or steel construction and ribbed for strength.

#### 2.6 MANHOLE AND DUCT

All manhole and duct products shall conform to RUS REA TE&CM 643-02.

##### 2.6.1 New Manholes

New manholes shall be equipped with pulling-in irons, cable racks, and ground rod, and conform to the requirements of RUS REA Bulletin 345-151. Manholes shall be designed so that the main trunk conduits enter and exit near the center of the ends, and lateral conduits exit on the sides near the corners. Manholes may be pre-cast or cast in place.

##### 2.6.2 NOT USED

##### 2.6.3 Duct/Conduit

Conduit shall be furnished as specified in Sections 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on project drawings.

##### 2.6.4 Innerduct

Innerduct shall be SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

##### 2.7 NOT USED

##### 2.8 NOT USED

#### 2.9 PROTECTOR MODULES

The protector modules shall be of the two-element gas tube type. Protection modules shall be heavy duty, A>10 kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current per ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, be equipped with an external spark gap and heat coils, and shall comply with UL 497.

##### 2.10 NOT USED

#### 2.11 MISCELLANEOUS ITEMS

##### 2.11.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with RUS REA PE-33.

##### 2.11.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

### 2.11.3 Warning Tape

Marking and locating tape shall be acid and alkali resistant polyethylene film, 6 inches wide with a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion and shall be specifically manufactured for marking and locating underground utilities. The warning tape shall be orange in color and continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 48 inch intervals.

### 2.11.4 Cable Warning Signs

Cable warning signs, which identify the route of buried cable, shall be stake mounted. The stake shall be driven into undisturbed soil and the sign shall be mounted to the stake in accordance with the manufacturer's instructions. Warning signs shall be placed at intervals of no more than 500 feet and at each change of direction in the cable route. Warning signs shall also be placed on each side of every crossing of surface obstacles such as roads, railroads, stream crossings, or any similar crossing where excavation is likely to occur.

## PART 3 EXECUTION

### 3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All installation work shall be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and NFPA 70.

#### 3.1.1 Cable Inspection and Repair

All cable and wire used in the construction of the project shall be handled with care. Each reel shall be inspected for cuts, nicks or other damage. All damage shall be repaired to the satisfaction of the Contracting Officer. The reel wrap shall remain intact on the reel until the cable or wire is ready to be placed.

#### 3.1.2 NOT USED

#### 3.1.3 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in RUS REA Bulletin 1751F-641.

##### 3.1.3.1 Cable Pulling

For cable installed in ducts and conduit, a cable feeder guide shall be used, between the cable reel and the face of the duct and conduit, to protect the cable and guide it into the duct and conduit as it is paid off the reel. As the cable is paid off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is paid off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not

cause the cable to be twisted or stretched.

#### 3.1.3.2 Penetrations for Cable Access

Penetrations in walls, ceilings or other parts of the building, made to provide for cable access, shall be caulked and sealed. Where conduits and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in section 07270 FIRE STOPPING. Fire stopped penetrations shall not compromise the fire rating of the walls or floors. All underground building entries shall be through waterproof facilities.

#### 3.1.3.3 Cable Bends

Telephone cable bends shall have a radius of not less than 10 times the cable diameter. Only large radius sweeps shall be used in conduit runs and shall not exceed a cumulative 90 degrees between manholes.

#### 3.1.4 Aerial Cable

Aerial cable installation shall be accomplished in accordance with the requirements set forth in RUS REA TE&CM 635-03.

#### 3.1.5 Manhole and Ducts

Manhole and duct systems shall be installed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Manholes shall be placed in line with the main duct. Splice cases shall be mounted in the center on the long sides. Lateral conduits shall exit the long sides near the corners.

##### 3.1.5.1 Innerduct Installation

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be plugged at both ends with polyurethane foam duct seal; this material shall also be inserted between the innerduct and the duct if cables are placed in the innerducts. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 2 inches exposed.

##### 3.1.5.2 Pull Cord

Pull cords of 3/8 inch polypropylene shall be installed in all unused ducts and inner-ducts with a minimum of 2 feet spare cord protruding from each end.

### 3.2 SPLICING

#### 3.2.1 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with RUS Bulletin 1753F-401(PC-2). Modular splicing shall be used on all cables larger than 25 pairs.

#### 3.2.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with the manufacturer's recommendation; each splice shall have a loss of less than 0.1 dB.

### 3.3 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable

splices, and terminals shall be grounded. Grounding shall be in accordance with requirements of NFPA 70, Articles 800-33 and 800-40.

### 3.3.1 Ground Bars

#### 3.3.1.1 Telecommunications Master Ground Bar (TMGB)

A copper TMGB shall be provided, in accordance with EIA ANSI/TIA/EIA-607, to be the hub of the basic grounding system by providing a common point of connection for ground from outside cable, MDF, and equipment. The TMGB shall have a ground resistance, including ground, of 10 ohms or less.

#### 3.3.1.2 Telecommunications Ground Bar (TGB)

Copper TGB shall be provided in accordance with EIA ANSI/TIA/EIA-607 in each communications closet and room and each frame. The TGB shall be connected to the TMGB in accordance with EIA ANSI/TIA/EIA-607. Each TGB shall be connected to the TMGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 ohms.

### 3.3.2 Incoming Outside Plant Cables

All incoming outside plant cable shields shall be bonded directly to the TMGB or the closest TGB.

### 3.3.3 Cable Stubs

All shields of cable stubs shall be bonded to a TGB located on the frame.

### 3.3.4 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs.

### 3.3.5 Protection Assemblies

The protector assemblies shall be mounted directly on the vertical frame ironwork. The assemblies mounted on each vertical frame shall be connected with a No. 6 AWG copper conductor to provide a low resistance path to the TGB.

### 3.3.6 Manholes

The shields of all cables in each manhole shall be bonded together by a bonding wire or ribbon. At intermediate manholes, where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of spliced cables shall be attached to it.

## 3.4 CUTOVER AND RECORDS

All necessary transfers and cutovers, shall be accomplished by the Contractor.

## 3.5 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test; testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans

shall identify the capabilities and functions to be tested.

### 3.5.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with RUS REA PC-4:

- a. Shield continuity.
- b. Conductor continuity.
- c. Conductor insulation resistance.
- d. Structural return loss.
- e. Cable insertion loss and loss margin at carrier frequencies.
- f. Shield ground for single jacketed cables.
- g. DC loop resistance.

-- End of Section --

## SECTION 16751

## CLOSED CIRCUIT TELEVISION SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

## DEPARTMENT OF DEFENSE (DOD)

DOD 3235.1 (Rev H) Test & Evaluation of System  
Reliability Availability and  
Maintainability - A Primer

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 170 (1957) Electrical Performance Standards -  
Monochrome Television Studio Facilities

EIA ANSI/EIA/TIA-232-E (1991) Interface Between Data Terminal  
Equipment and Data Circuit-Terminating  
Equipment Employing Serial Binary Data  
Interchange

EIA ANSI/EIA-310-D (1992) Cabinets, Racks, Panels, and  
Associated Equipment

EIA ANSI/EIA-330 (1968) Electrical Performance Standards  
for Closed Circuit Television Camera  
525/60 Interlaced 2:1

EIA ANSI/EIA-375-A-1976 (1974) Electrical Performance Standards  
for Direct View Monochrome Closed Circuit  
Television Monitors 525/60 Interlaced 2:1

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC  
Power Circuits

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

## UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 1410 (1997) Television Receivers and  
High-Voltage Video Products

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General

The Contractor shall configure the system as described and shown. All television equipment shall conform to EIA 170 specifications. The system shall include all connectors, adapters, and terminators necessary to interconnect all equipment. The Contractor shall also supply all cabling necessary to interconnect the closed circuit television (CCTV) equipment installed in the Security Center, and interconnect equipment installed at remote control/monitoring stations.

### 1.2.2 System Overall Reliability Requirement

The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF) of at least 5000 hours, and shall be calculated based on the configuration specified in paragraph "System Overall Reliability Calculations."

### 1.2.3 Power Line Surge Protection

All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

### 1.2.4 Video and Sync Signal Transmission Line Surge Protection

All cable, except fiber optic cable, used for sync or video signal transmission shall include protective devices to safeguard the CCTV equipment against surges. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. The surge suppression device shall be capable of dissipating not less than 1500 watts for 1 millisecond, and the response time from zero volts to clamping shall not be greater than 5 nanoseconds. Fuses shall not be used for surge protection.

### 1.2.5 Control Line Surge Protection

All cables and conductors, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against surges and shall have surge protection installed at each end. Protection shall be furnished at the equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

### 1.2.6 Power Line Conditioners

A power line conditioner shall be furnished for the security console CCTV equipment. The power line conditioner shall be of the ferroresonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The power line conditioner shall be sized for 125 percent of the actual connected kVA load. Characteristics of the power line conditioner shall be as follows:

- a. At 85 percent load, the output voltage shall not deviate by more

than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

- b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.
- c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

#### 1.2.7 Video and Control Signal Data Transmission Media

The Contractor shall provide a video and data and control signal transmission system as specified in Section 16768.

#### 1.2.8 Environmental Conditions

##### 1.2.8.1 Field Equipment

The cameras and all other field equipment shall be rated for continuous operation under ambient environmental conditions of 14 degrees to 120 degrees F using no auxiliary heating or cooling equipment. Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, wind loading, ice loading, and vibration conditions specified or encountered for the installed location.

##### 1.2.8.2 Security Center Equipment

Security Center and remote control/monitoring station equipment shall, unless designated otherwise, be rated for continuous operation under ambient environmental conditions of 60 degrees F to 85 degrees F and a relative humidity of 20 to 80 percent.

#### 1.2.9 Electrical Requirements

Electrically powered IDS equipment shall operate on 120 volt 60 Hz AC sources as shown. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

All electrical and electronic equipment in the console shall be powered from an UPS. The UPS shall provide 4 hours battery back-up in the event of primary failure. Batteries shall be sealed non-outgassing type.

#### 1.3 DELIVERY OF TECHNICAL DATA AND COMPUTER SOFTWARE

All items of computer software and technical data (including technical data which relates to computer software), which are specifically identified in this specification shall be delivered strictly in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, Section 01330 SUBMITTAL PROCEDURES, and in accordance with the Contract Data Requirements List (CDRL), DD Form 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. If the CCTV system is being installed in conjunction with an IDS or EECS the CCTV Technical Data Packages shall be submitted as part of the Technical Data Packages for Section 16725 INTRUSION DETECTION SYSTEMS, or Section 16752 ELECTRONIC ENTRY CONTROL SYSTEMS.

##### 1.3.1 Group I Technical Data Package

###### 1.3.1.1 System Drawings

The data package shall include the following:

- a. System block diagram.
- b. CCTV system console installation, block diagrams, and wiring diagrams.
- c. Security center CCTV equipment installation, interconnection with console equipment, block diagrams and wiring diagrams.
- d. Remote control/monitoring station installation, interconnection to security center including block diagrams and wiring diagrams.
- e. Camera wiring and installation drawings.
- f. Pan/tilt mount wiring and installation drawings.
- g. Interconnection with video signal transmission system, block diagrams and wiring diagrams.
- h. Surge protection device installation.

#### 1.3.1.2 Manufacturers' Data

The data package shall include manufacturers' data for all materials and equipment and security center equipment provided under this specification.

#### 1.3.1.3 System Description and Analyses

The data package shall include complete system descriptions, analyses and calculations used in sizing the equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance of this specification. The data package shall include the following:

- a. Switcher matrix size.
- b. Camera call-up response time.
- c. System start up and shutdown operations.
- d. Switcher programming instructions.
- e. Switcher operating and maintenance instructions.
- f. Manuals for CCTV equipment.
- g. Data entry forms.

#### 1.3.1.4 Software Data

The data package shall consist of descriptions of the operation and capability of system and application software as specified.

#### 1.3.1.5 Overall System Reliability Calculations

The data package shall include all manufacturer's reliability data and calculations required to show compliance with the specified reliability. The reliability data shall be prepared using DOD 3235.1 as a guide. The calculations shall be based on all CCTV equipment associated with one camera circuit and the console CCTV equipment, excluding the data transmission media (DTM).

#### 1.3.1.6 Certifications

All specified manufacturer's certifications shall be included with the data package.

#### 1.3.2 Group II Technical Data Package

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall submit a report to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. For those changes or conditions which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct any deficiency without written permission from the Government.

#### 1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the predelivery test. The Contractor shall deliver the predelivery test procedures to the Government for approval. After receipt by the Contractor of written approval of the predelivery test procedures, the Contractor may schedule the predelivery test. The final predelivery test report shall be delivered after completion of the predelivery test.

#### 1.3.4 Group IV Technical Data Package

The Contractor shall prepare test procedures and reports for the performance verification test and the endurance test. The Contractor shall deliver the performance verification test and endurance test procedures to the Government for approval. After receipt by the Contractor of written approval of the test procedures, the Contractor may schedule the tests. The contractor shall provide a report detailing the results of the field test and a video tape as specified in paragraph "Contractor's Field Testing." The final performance verification and endurance test report shall be delivered after completion of the tests.

##### 1.3.4.1 Operation and Maintenance Manuals

A draft copy of the operation and maintenance manuals, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

##### 1.3.4.2 Training Documentation

Lesson plans and training manuals for the training phases, including type of training to be provided with a sample training report, and a list of reference material, shall be delivered for approval.

##### 1.3.4.3 Data Entry

The Contractor shall enter all data needed to make the system operational. The Contractor shall deliver the data to the Government on data entry forms, utilizing data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession required for complete installation of the data base. The Contractor shall identify and request from the Government, any additional data needed to provide a complete and operational CCTV system. The completed forms shall be delivered to the Government for review and approval at least 90 days prior to the Contractor's scheduled need date.

#### 1.3.5 Group V Technical Data Package

Final copies of the manuals as specified bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the

manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance.

#### 1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

#### 1.3.5.2 Hardware Manual

A manual shall describe all equipment furnished, including:

- a. General hardware description and specifications.
- b. Installation and checkout procedures.
- c. Equipment electrical schematics and layout drawings.
- d. System schematics and wiring lists.
- e. System setup procedures.
- f. Manufacturer's repair parts list indicating sources of supply.
- g. Interface definition.

#### 1.3.5.3 Software Manual

The software manual shall describe the functions of all software, and shall include all other information necessary to enable proper loading, testing and operation, including:

- a. Definitions of terms and functions.
- b. Procedures for system generation.
- c. Description of implementation of the program.
- d. Description of required sequences.
- e. Directory of all disk files.
- f. Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer.

#### 1.3.5.4 Operator's Manual

The operator's manual shall explain all procedures and instructions for operation of the system including:

- a. Video switcher.
- b. Cameras and video recording equipment.

- c. Use of the software.
- d. Operator commands.
- e. System start-up and shut-down procedures.
- f. Recovery and restart procedures.

#### 1.3.5.5 Maintenance Manual

The maintenance manual shall describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

#### 1.3.5.6 Final System Drawings

The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the CCTV system to be used for final system drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the CCTV system and shall be delivered to the Government with the final endurance test report. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the final system drawings, a representative of the Government will review the final system work with the Contractor. If the final system work is not complete, the Contractor will be so advised and shall complete the work as required. Final drawings submitted with the endurance test report shall be finished drawings on mylar or vellum.

### 1.4 TESTING

#### 1.4.1 General

The Contractor shall perform predelivery testing, site testing, and adjustment of the completed CCTV system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific test procedures.

#### 1.4.2 Test Procedures and Reports

Test procedures shall explain, in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

### 1.5 TRAINING

#### 1.5.1 General

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the CCTV system as specified. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be delivered for each trainee with two additional manuals delivered for archiving at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor is responsible for furnishing all audio-visual equipment and all other training materials and supplies. Where the Contractor presents portions of the course through the use of audio-visual material, copies of the audio-visual materials shall be delivered to the Government, either as a part of the printed training manuals or on the same media as that used during the training sessions. A training day is 8 hours of instruction,

including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the facility. For guidance in planning the required instruction, the Contractor should assume the attendees will have a high school education or equivalent. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

#### 1.5.2 Operator's Training

The course shall be taught at the project site for five consecutive training days during or after the Contractor's field testing. A maximum of 12 personnel will attend the course. No part of the training given during this course will be counted toward completion of the performance verification test. The course shall consist of classroom instruction, hands-on training, instruction on the specific hardware configuration of the installed system, and specific instructions for operating the installed system. The course shall demonstrate system start up, system operation, system shutdown, system recovery after a failure, the specific hardware configuration, and operation of the system and its software. The students should have no unanswered questions regarding operation of the installed CCTV system. The Contractor shall prepare and insert additional training material in the training manuals when the need for additional material becomes apparent during instruction. The Contractor shall prepare a written report after the completion of the course. The Contractor shall list in the report the times, dates, attendees and material covered at each training session. The Contractor shall describe the skill level of each student at the end of this course. The Contractor shall submit the report before the end of the performance verification test. The course shall include:

- a. General CCTV hardware, installed system architecture and configuration.
- b. Functional operation of the installed system and software.
- c. Operator commands.
- d. Alarm interfaces.
- e. Alarm reporting.
- f. Fault diagnostics and correction.
- g. General system maintenance.
- h. Replacement of failed components and integration of replacement components into the operating CCTV system.

#### 1.6 MAINTENANCE AND SERVICE

##### 1.6.1 General Requirements

The Contractor shall provide all services required and equipment necessary to maintain the entire CCTV system in an operational state as specified for a period of 1 year after completion of the endurance test, and shall provide all necessary material required for the work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other unscheduled work.

##### 1.6.2 Description of Work

The adjustment and repair of the CCTV system includes all computer equipment, software updates, signal transmission equipment, and video equipment. Provide the manufacturer's required adjustments and all other work necessary.

### 1.6.3 Personnel

Service personnel shall be qualified to accomplish all work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

### 1.6.4 Schedule of Work

The Contractor shall perform two inspections at 6-month intervals or less. This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. These inspections shall include:

- a. Visual checks and operational tests of the CPU, switcher, peripheral equipment, interface panels, recording devices, monitors, video equipment electrical and mechanical controls, and a check of the picture quality from each camera.
- b. Run system software and correct all diagnosed problems.
- c. Resolve any previous outstanding problems.

### 1.6.5 Emergency Service

The Government will initiate service calls when the CCTV system is not functioning properly. Qualified personnel shall be available to provide service to the complete CCTV system. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 24 hours after receiving a request for service. The CCTV system shall be restored to proper operating condition within 3 calendar days after receiving a request for service.

### 1.6.6 Operation

Performance of scheduled adjustments and repair shall verify operation of the CCTV system as demonstrated by the applicable portions of the performance verification test.

### 1.6.7 Records and Logs

The Contractor shall keep records and logs of each task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain calibration, repair, and programming data. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the CCTV system.

### 1.6.8 Work Requests

The Contractor shall separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within 5 days after work is completed.

### 1.6.9 System Modifications

The Contractor shall make any recommendations for system modification in writing to the Government. No system modifications, including operating parameters and control settings, shall be made without prior approval of

the Government. Any modifications made to the systems shall be incorporated into the operations and maintenance manuals, and other documentation affected.

#### 1.6.10 Software

The Contractor shall recommend all software updates to the Government for approval. Upon Government approval, updates shall be accomplished in a timely manner, fully coordinated with the CCTV system operators, operation in the system verified, and shall be incorporated into the operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the manufacturer's software.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

All system hardware and software components shall be produced by manufacturers regularly engaged in the production of CCTV equipment. Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Equipment located at the security center or a remote control/monitoring station shall be rack mounted as shown. Television equipment shall comply with 47 CFR 15, Subparts C and H. Computing devices shall comply with 47 CFR 15, Subpart J.

##### 2.1.1 NOT USED

##### 2.1.2 Soldering

All soldering shall be done in accordance with standard industry practices.

#### 2.2 ENCLOSURES

The Contractor shall provide metallic enclosures as needed for equipment not housed in racks or supplied with a housing. The enclosures shall be as specified or shown.

##### 2.2.1 Interior

Enclosures to house equipment in an interior environment shall meet the requirements of NEMA 250 Type 12.

##### 2.2.2 Exposed-to-Weather

Enclosures to house equipment in an outdoor environment shall meet the requirements of NEMA 250 Type 4X.

##### 2.2.3 Interior Equipment Rack

Rack kits are designed to convert desktop equipment to rack mount units for use in standard 19-inch EIA racks or consoles. All rack kits have a black polyester powder coat finish to match the exterior finish of the equipment.

#### 2.3 NOT USED

#### 2.4 LOCKS AND KEY-LOCK OPERATED SWITCHES

##### 2.4.1 Locks

All locks required to be installed on system enclosures for maintenance purposes shall be UL listed, round-key type, with three dual, one mushroom,

and three plain pin tumblers or conventional key type lock having a combination of five cylinder pin and five-point three position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." The locks shall be so arranged that the key can only be withdrawn when in the locked position. All maintenance locks shall be keyed alike and only two keys shall be furnished for all of these locks.

## 2.5 NOT USED

## 2.6 TUBE CAMERA

The video camera shall conform to EIA 170 and EIA ANSI/EIA-330 specifications. All electronic components and circuits shall be solid state except for the imaging tube. Signal-to-noise ratio shall not be less than 43 dB unweighted. Geometric distortion shall not exceed 2 percent in any area of the picture. The lens mount shall be a C-mount, and the camera shall have an externally accessible back focus adjustment. The camera shall operate from 14 to 120 degrees F without auxiliary heating or cooling, and shall not exhibit any change in picture quality or resolution.

The camera shall operate on 60 Hz AC power, and shall be capable of operating over a voltage range of 105 to 130 or 205 to 240 as shown on drawings.

### 2.6.1 Type of Tube

The tube shall be a 1 inch format vidicon image tube, and shall be free of blemishes. The camera shall provide not less than 650 lines of horizontal resolution at the center of the picture, and resolution shall not vary more than 50 lines after 5,000 hours of use.

### 2.6.2 Sensitivity

The Camera shall provide full video without camera automatic gain with a scene reflectivity of 75 percent using an f/1.4 lens giving a camera faceplate illumination at 2850 K of 0.0046 footcandle.

### 2.6.3 Camera Synchronization

The camera shall have an input for external sync, and shall automatically switch over to internal sync if external sync is not present. The camera shall also have the capability of synchronization by line-locking to the AC power 60 Hz line frequency at the zero crossing point, and shall provide not less than plus or minus 90 degrees of vertical phase adjustment.

### 2.6.4 Connectors

Cameras with lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors and wiring as needed to operate the lens functions. Video signal output connector shall be a bayonet connector (BNC). Cameras with integral fiber optic video transmitters shall have straight-tip bayonet type fiber optic video output connectors. A connector shall be provided for external sync input.

### 2.6.5 Automatic Circuits

The camera shall have automatic scan failure protection for both horizontal and vertical drives. The camera shall have automatic beam control, automatic black level, automatic white clipper, automatic gain control, and automatic target voltage limiting circuitry.

## 2.7 NOT USED

## 2.8 CAMERA LENSES

Camera lenses shall be all glass with coated optics. The lens mount shall

be a C-mount. The lens shall be supplied with the camera, and shall have a maximum f-stop opening of f/1.4 or the maximum available for the focal length specified. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lens focal lengths shall be as shown or specified in the lens table.

## 2.9 CAMERA HOUSING

The camera and lens shall be enclosed in a tamper resistant housing as defined in the following specification. Any ancillary housing mounting hardware needed to install the housing at the camera location shall be provided as part of the housing.

### 2.9.1 Environmentally Sealed Camera Housing

The housing shall be designed to provide a condensation free environment for camera operation. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be equipped with supplementary camera mounting blocks or supports as needed for pan/tilt unit mounting centerline. All electrical and signal connections required for operation of the camera, pan/tilt motor, heater, and lens shall be supplied. The housing shall provide the environment needed for camera operation, and shall keep the viewing window free of fog, snow, and ice. The housing shall be equipped with a sunshield, and both the housing and the sunshield shall be white. A mounting bracket which can be adjusted to center the weight of the housing and camera assembly shall be provided as part of the housing. Heater and thermostat shall be provided in housing. Heating strips to be UL listed and constructed from 4-ply fiberglass-supported silicone rubber. Each strip backed with 20 mil aluminum. Thermostat closes at 35 deg. F and opens at 50 deg. F. Supply voltage to match camera, etc.

## 2.10 VIDEO MONITOR

The monitor shall conform to EIA 170, EIA ANSI/EIA-375-A-1976, and UL 1410 specifications. All electronic components and circuits shall be solid state except for the picture tube. The monitor shall operate on 120 volts 60 Hz AC power, shall have a stabilized high voltage power supply, and regulated low voltage power supplies. The monitor shall have automatic frequency control (AFC), bandwidth greater than 7 MHz, and horizontal resolution not less than 700 lines at the center of the picture tube. The monitor shall be capable of reproducing a minimum of 10 discernable shades of gray as described in EIA ANSI/EIA-375-A-1976. The video input shall accept composite video with switchable loop-through or 75 ohm termination.

### 2.10.1 Picture Tube

The monitor shall have a 20 inch picture tube measured diagonally.

### 2.10.2 Configuration

The monitor shall be rack-mounted.

### 2.10.3 Controls

Front panel controls shall be provided for power on/off, horizontal hold, vertical hold, contrast, and brightness. The monitor shall have switchable DC restoration.

### 2.10.4 Connectors for Video Monitor

Video signal input and output shall be by BNC connectors.

## 2.11 VIDEO SWITCHER

The switcher shall conform to EIA 170 specifications, and shall be a vertical interval switcher. Electronic components, subassemblies, and circuits of the switcher shall be solid state. The switcher shall be microprocessor based and software programmable. The switcher shall be a modular system that shall allow for expansion or modification of inputs, outputs, alarm interfaces, and secondary control stations by addition of the appropriate modules. Switcher components shall operate on 120 volts 60 Hz AC power. The switcher central processor unit shall be capable of being interfaced to a master security computer for integrated operation and control. The video switcher central processing unit (CPU) shall have the capability of accepting time from a master clock supplied in ASCII format through an EIA ANSI/EIA/TIA-232-E input. All components, modules, cables, power supplies, software, and other items needed for a complete and operable CCTV switching system shall be provided. Switcher equipment shall be rack mounted unless otherwise specified. Rack mount hardware shall be supplied to mount the switcher components in a standard 19 inch rack as described in EIA ANSI/EIA-310-D.

### 2.11.1 Switcher Software

The switcher shall be software programmable, and the software shall be supplied as part of the switcher. The software shall be installed in the switcher CPU, and shall be configured as required by the site design. Changes or alterations of features under software control shall be accomplished through software programming without changes in hardware or system configuration. The switcher shall retain the current program for at least 4 hours in the event of power loss, and shall not require reprogramming in order to restart the system.

### 2.11.2 Switcher Matrix

The switcher shall be a programmable crosspoint switcher capable of switching any video input to any video output.

### 2.11.3 NOT USED

### 2.11.4 Switcher Response Time and Alarm Processing

The switcher response time shall not be greater than 200 milliseconds from the time the alarm is sensed at the switcher alarm interface, until the picture is displayed on the monitor. The switcher shall continue to process subsequent alarms and shall put them in a queue. The operator shall be able to view the alarms in queue by operating an alarm release function which switches the subsequent alarms to the monitor in the order of occurrence.

### 2.11.5 Control Keyboards

Control and programming keyboards shall be supplied for the video switcher at the security center, and control keyboards shall be supplied for any control/monitoring stations as shown. The control keyboard shall provide the interface between the operator and the CCTV system, and shall relay commands from the operator to the switcher CPU. The keyboard shall provide control of the video switcher functions needed for operation and programming of the video switcher. Controls shall include, but not be limited to: programming the switcher, switcher control, lens function control, pan/tilt/zoom (PTZ) control, control of environmental housing accessories, and annotation programming. If the switcher CPU requires an additional text keyboard for system management functions, the keyboard shall be supplied as part of the video switcher.

#### 2.11.6 Accessory Control Equipment

The video switcher shall be equipped with signal distribution units, preposition cards, expansion units, cables, software or any other equipment needed to ensure that the CCTV system is complete and fully operational.

#### 2.11.7 Connectors for Video Switcher

Video signal input and output shall be by BNC connectors.

#### 2.11.8 Video Annotation

Video annotation equipment shall be provided for the video switcher. The annotation shall be alphanumeric and programmable for each video source. Annotation to be generated shall include, but not be limited to: individual video source identification number, time (hour, minute, second) in a 24 hour format, date (month, day, year), and a unique, user-defined title with at least 8 characters. The annotation shall be inserted onto the source video so that both shall appear on a monitor or recording. The lines of annotation shall be movable for horizontal and vertical placement on the video picture. The annotation shall be automatically adjusted for date. Programmed annotation information shall be retained in memory for at least 4 hours in the event of power loss.

#### 2.12 NOT USED

#### 2.13 NOT USED

#### 2.14 NOT USED

#### 2.15 CAMERA SUPPORT EQUIPMENT

The camera and lens contained in a camera housing shall be installed on a camera support as shown. Any ancillary mounting hardware needed to install the support and to install the camera on the support shall be provided as part of the support. The camera support shall be capable of supporting the equipment to be mounted on it including wind and ice loading normally encountered at the site.

#### 2.16 NOT USED

#### 2.17 WIRE AND CABLE

The Contractor shall provide all wire and cable. All wire and cable components shall be able to withstand the environment the wire or cable is installed in for a minimum of 20 years.

##### 2.17.1 CCTV Equipment Video Signal Wiring

The coaxial cable shall have a characteristic impedance of 75 ohms plus or minus 3 ohms. RG-6 coaxial signal cable shall have shielding which provides a minimum of 95 percent coverage, a solid copper center conductor of not less than 23 AWG, polyethylene insulation, and a black non-contaminating polyvinylchloride (PVC) jacket.

##### 2.17.2 Low Voltage Control Wiring

Twisted pair low voltage control wiring to be used above ground or as direct burial cable shall be provided. Plenum or riser cables shall be IEEE C2 CL2P certified.

##### 2.17.3 Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at

the security center or at a secondary control/monitoring site shall be not less than 20 AWG and shall be stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100 percent coverage. Cables with a single overall shield shall have a tinned copper shield drain wire. Plenum or riser cables shall be IEEE C2 CL2P certified.

#### 2.18 RECEIVER/DRIVER

The receiver/driver operates on the principle of transferring control information and video on the same line. A train of pulses containing control data is superimposed on the vertical blanking interval of the video signal.

Standard features include pan/tilt control, camera power, zoom lens control (zoom, iris, and focus with adjustable speed - speed not remote controllable), and an open collector transistor (latching) output for use in manual override of an automatic iris control.

#### 2.19 WEATHERPROOF POWER SUPPLY

The power supplies provide 24 VAC output for 1-4 cameras. To compensate for voltage losses over long wire runs. The power supplies have a selectable input of 120 or 230 VAC.

The power supplies are capable of handling pan/tilt, heater, and blower operation in addition of the camera.

The power supply is a four-output supply capable of handling up to 20 amps (480 vA) of total load. Power supply is available with fuses on each output. Fuses provide a greater degree of protection for the camera because they are faster acting and more precise.

Enclosure shall be NEMA 4, aluminum, with a gray polyester powder coat.

#### 2.20 COAXIAL SIGNAL AMPLIFIER

Coax amp provides a low cost, highly effective means of maintaining CCTV picture quality in runs of up to 4,500 feet of RG-6 coaxial cable and also maintains the quality of the control signal. Through panel controls provide for adjustable amplifier flat gain of 1-8 dB, plus adjustable high frequency boost of from 0 to greater than 18 dB at 12 MHz, maintaining full video amplitude, contrast and detail.

The Amp features all solid-state circuitry and is supplied with a UL listed wall transformer.

Applications of the EA2000 should be for post-equalization only (located near the monitoring equipment); use as a pre-equalizer is discouraged.

Three units can be racked mounted, or two units can be mounted side-by-side in one chassis.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system. All interior wiring, including low voltage wiring outside the security center control console and equipment racks, cabinets, boxes and similar enclosures, shall be installed in rigid, galvanized steel conduit conforming to UL 6.

Interconnection wiring between components mounted in the same rack or cabinet does not need to be installed in conduits. Minimum conduit size shall be 1/2 inch. Connections shall be tight tapered threaded. No threadless fittings or couplings shall be used. Conduit enclosures shall be cast metal or malleable iron with threaded hubs or bodies. Electric metallic tubing (EMT), armored cable, nonmetallic sheathed cables, or flexible conduit will not be permitted except where specifically shown. DTM shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the CCTV system, except where specifically shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.1.1 NOT USED

3.1.2 NOT USED

3.1.3 Enclosure Penetrations

All enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.1.4 Cold Galvanizing

All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.5 Interconnection of Console Video Equipment

The Contractor shall connect signal paths between video equipment with RG-6 coaxial cable. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.

3.1.6 Cameras

The Contractor shall install the cameras with the proper focal length lens as indicated for each zone; connect power and signal lines to the camera; set cameras with fixed iris lenses to the proper f-stop to give full video level; aim camera to give field of view as needed to cover the alarm zone; aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun; focus the lens to give a sharp picture over the entire field of view; and synchronize all cameras so the picture does not roll on the monitor when cameras are selected.

3.1.7 Monitors

The Contractor shall install the monitors as shown and specified; connect all signal inputs and outputs as shown and specified; terminate video input signals as required; and connect the monitor to AC power.

3.1.8 Switcher

The Contractor shall install the switcher as shown and according to manufacturer's instructions; connect all subassemblies as specified by the

manufacturer and as shown; connect video signal inputs and outputs as shown and specified; terminate video inputs as required; connect alarm signal inputs and outputs as shown and specified; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer and as shown; connect the switcher CPU and switcher subassemblies to AC power; load all software as specified and required for an operational CCTV system configured for the site requirements, including data bases, operational parameters, and system, command, and application programs; provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test; and program the video annotation for each camera.

3.1.9 NOT USED

3.1.10 NOT USED

3.1.11 Camera Mount

The Contractor shall: install the camera mount as specified by the manufacturer and as shown; provide mounting hardware sized appropriately to secure the mount, camera and housing with maximum wind and ice loading encountered at the site; provide electrical and signal transmission cabling to the mount location; connect signal lines and AC power to mount interfaces; connect pole wiring harness to camera.

3.1.12 Pan/Tilt Mount

The Contractor shall install pan/tilt mount, receiver/driver and mount appurtenances as specified by the manufacturer and as shown; supply mounting hardware sized appropriately to secure pan/tilt, camera and housing with maximum wind and ice loading encountered at the site; install pan/tilt control wiring; and connect pan/tilt to control wiring and AC power.

3.2 SYSTEM STARTUP

The Contractor shall not apply power to the CCTV system until the following items have been completed:

- a. CCTV system equipment items and DTM have been set up in accordance with manufacturer's instructions.
- b. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
- c. System wiring has been tested and verified as correctly connected as indicated.
- d. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
- e. Power supplies to be connected to the CCTV system have been verified as the correct voltage, phasing, and frequency as indicated.
- f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 NOT USED

3.4 SITE TESTING

### 3.4.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. The Government will witness all performance verification and endurance testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test.

### 3.4.2 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing.

The report shall also include a copy of the approved performance verification test procedure. In addition, the Contractor shall make a master video tape recording showing typical day and night views of each camera in the system and shall deliver the tape with the report. Note any objects in the field of view that might produce highlights that could cause camera blinding. Note any objects in the field of view or anomalies in the terrain which may cause blind spots. Note if a camera cannot be aimed to cover the zone and exclude the rising or setting sun from the picture. Note night assessment capabilities and whether lights or vehicle headlights cause blooming or picture degradation. If any of the above conditions or other conditions exist that cause picture degradation or interfere with the camera field of view, the Contractor shall inform the Contracting Officer. The tape shall be recorded using the video recorder installed as part of the CCTV system. If a recorder is not part of the CCTV system, the Contractor shall provide the tape in Video Home System (VHS) format. The Contractor shall provide the Government with the original tape as part of the documentation of the system and shall submit a letter certifying that the CCTV system is ready for performance verification testing. The field testing shall as a minimum include:

- a. Verification that the video transmission system and any signal or control cabling have been installed, tested, and approved.
- b. When the system includes remote control/monitoring stations or remote switch panels, verification that the remote devices are functional, communicate with the security center, and perform all functions as specified.
- c. Verification that the switcher is fully functional and that the switcher software has been programmed as needed for the site configuration.
- d. Verification that switcher software is functioning correctly. All software functions shall be exercised.
- e. Operation of all electrical and mechanical switcher controls and verification that the control performs the designed function.
- f. Verification that all video sources and video outputs provide a full bandwidth signal that complies with EIA 170 at all video inputs.
- g. Verification that all video signals are terminated properly.
- h. Verification that all cameras are aimed and focused properly. The Contractor shall conduct a walk test of the area covered by each

camera to verify the field of view.

- i. Verification that cameras facing the direction of rising or setting sun are aimed sufficiently below the horizon so that the camera does not view the sun directly.
- j. If vehicles are used in proximity of the assessment areas, verification of night assessment capabilities and determination if headlights cause blooming or picture degradation.
- k. Verification that all cameras are synchronized and that the picture does not roll when cameras are switched.
- l. When pan/tilt mounts are used in the system, verification that the limit stops have been set correctly. Verification of all controls for pan/tilt or zoom mechanisms are operative and that the controls perform the desired function. If preposition controls are used, verification that all home positions have been set correctly, and have been tested for auto home function and correct home position.

The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

#### 3.4.3 Performance Verification Test

The Contractor shall demonstrate that the completed CCTV system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the Government, based on the Contractor's written report. This shall include certification of successful completion of Contractor Field Testing as specified in paragraph "Contractor's Field Testing," and upon successful completion of training as specified. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

-- End of Section --

## SECTION 16768

## FIBER OPTIC DATA TRANSMISSION SYSTEM

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 170	(1957) Electrical Performance Standards - Monochrome Television Studio Facilities
EIA ANSI/TIA/EIA-455-13A	(1996) FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies
EIA ANSI/EIA/TIA-455-25B	(1996) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies
EIA ANSI/EIA/TIA-455-30B	(1991) FOTP-30 Frequency Domain Measurement of Multimode Optical Fiber Information Transmission Capacity
EIA ANSI/TIA/EIA-455-41A	(1993) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables
EIA ANSI/EIA/TIA-455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
EIA ANSI/EIA/TIA-455-47B	(1992) FOTP-47 Output Far Field Radiation Pattern Measurement
EIA ANSI/EIA/TIA-455-58A	(1990) FOTP-58 Core Diameter Measurement of Graded-Index Optical Fibers
EIA ANSI/EIA/TIA-455-59	(1989) FOTP-59 Measurement of Fiber Point Defects Using an OTDR
EIA ANSI/EIA/TIA-455-61	(1989) FOTP-61 Measurement of Fiber or Cable Attenuation Using an OTDR
EIA ANSI/EIA-455-65	(1988) FOTP-65 Optical Fiber Flexure Test
EIA ANSI/EIA-455-81A	(1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA ANSI/EIA/TIA-455-82B	(1992) FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
EIA ANSI/EIA-455-88	(1987) FOTP-88 Fiber Optic Cable Bend Test
EIA ANSI/EIA-455-91	(1986; R 1991) FOTP-91 Fiber Optic Cable Twist-Bend Test

EIA ANSI/TIA/EIA-455-104A	(1993) FOTP-104 Fiber Optic Cable Cyclic Flexing Test
EIA ANSI/EIA/TIA-455-170	(1989) FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power
EIA ANSI/EIA-455-171	(1987) FOTP-171 Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-Mode Optical Fiber Cable Assemblies
EIA ANSI/TIA/EIA-455-177A	(1992) FOTP-177 Numerical Aperture Measurement of Graded-Index Optical Fibers
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	
IEEE C2	(1997) National Electrical Safety Code
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA 250	(1991) Enclosures for Electrical Equipment (1000 volts Maximum)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1996; Errata) National Electrical Code
UNDERWRITERS LABORATORIES (UL)	
UL 910	(1995; Rev May 1995) Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 1666	(1997) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General

A fiber optics (FO) data transmission system (DTS) shall be provided. The data transmission system shall consist of fiber optic transmission media, transmitter and receiver modules, FO modems, transceiver modules, repeaters, power line surge protection and terminal devices (such as connectors, and breakout boxes). The data transmission system shall interconnect system components as shown. Computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class B computing devices and labeled as set forth in 47 CFR 15.

### 1.2.2 Environmental Requirements

Equipment and cable to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of 35 to 120 degrees F dry bulb and 10 to 95 percent relative humidity, noncondensing. Equipment shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location. Fiber optic cable for

outdoor installation shall be rated for minus 40 to plus 122 degrees F.

#### 1.2.3 NOT USED

#### 1.2.4 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

#### 1.2.5 Input Line Surge Protection

Inputs and outputs shall be protected against surges induced on wiring including wiring installed outdoors. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors (except fiber optics which serve as communications circuits from consoles to field equipment) and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

#### 1.3 DELIVERY OF TECHNICAL DATA

Computer software and technical data (including technical data which relates to computer software), which are specifically identified in this specification shall be delivered strictly in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, and in accordance with the Contract Data Requirements List (CDRL), DD Form 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. If the DTM system is being installed in conjunction with another system such as an intrusion detection system, electronic entry control system, closed circuit television system, energy monitoring and control system, or utility monitoring and control system, the Technical Data Packages shall be submitted as part of the Technical Data Package.

##### 1.3.1 Group I Technical Data Package

###### 1.3.1.1 System Drawings

The package shall include the following:

- a. Communications system block diagram.
- b. FO receivers, transmitters, transceivers, and FO modem installation, block diagrams, and wiring diagrams.
- c. FO receivers, transmitters, transceivers, and FO modem physical layout and schematics.
- d. Details of interfaces with other systems.
- e. Details of connections to power sources, including grounding.
- f. Details of surge protection device installations.

- g. Details of cable splicing and connector installations.
- h. Details of aerial cable and messenger installation on poles, cable entrance to buildings, and termination inside enclosures.
- i. Details of underground cable installation, cable entrance into buildings, and terminations inside enclosures.

#### 1.3.1.2 Equipment Data

A complete data package shall be delivered for all material, including field and system equipment.

#### 1.3.1.3 Data Transmission System Description and Analyses

The data package shall include complete system description, and analyses and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the specified performance. The data package shall include the following:

- a. FO receivers, transmitters, transceivers, FO modem transmit and receive levels, and losses in decibels (dB) on each communication link.
- b. Digital transmitter and receiver communication speed and protocol description.
- c. Analog signal transmission method and bandwidth of the transmitter and receiver.
- d. Data transmission system expansion capability and method of implementation.
- e. FO system signal-to-noise ratio calculation for each communication link.
- f. Flux-budget and gain margin calculation for each link.

#### 1.3.1.4 System Overall Reliability Calculations

The data package shall include manufacturers' reliability data and calculations required to show compliance with the specified reliability.

#### 1.3.1.5 Certifications

Specified manufacturer's certifications shall be included with the data package.

#### 1.3.2 Group II Technical Data Package

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall submit a report to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. For those changes or conditions which affect system installation or performance, specification sheets shall be provided (with the report), or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct any deficiency without written permission from the Government.

#### 1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the factory

test. A test plan and test procedures shall be prepared in accordance with Section 16751 and this specification. The test procedures shall describe the applicable tests to be performed, and other pertinent information such as specialized test equipment required, length of test, and location of the test. The procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of this specification, and the methods for simulating the necessary conditions of operation to demonstrate performance of the system. The test report shall describe the results of testing to include the date, time, location and system component designations of material and equipment tested. Testing action shall be recorded whether successful or not. Reasons for termination of testing shall be described. Testing work sheets, printouts, strip charts, oscilloscope or OTDR photographs, raw and analyzed data and testing conclusions shall be included in the report. The Contractor shall deliver the test procedures to the Government for approval. After receipt by the Contractor of written approval of the test procedures, the Contractor may schedule the factory test. The Contractor shall provide written notice of the test to the Government at least 2 weeks prior to the scheduled start. The final test report shall be delivered within 15 days after completion of the test.

#### 1.3.4 Group IV Technical Data Package

##### 1.3.4.1 Performance Verification and Endurance Testing Data

The Contractor shall prepare procedures and reports for the performance verification test and endurance test. Test procedures shall be prepared in accordance with Section 16751 and this specification. Testing shall use the configured and installed system as approved by the Government. Where required, the Contractor shall simulate conditions of operation to demonstrate the performance of the system. The test plan shall describe the applicable tests to be performed, other pertinent information such as specialized test equipment required, length of performance verification test and endurance test, and location of the performance verification test and endurance test. The procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of this specification, and the methods for simulating the necessary conditions of operation to demonstrate performance of the system.

The test report shall describe the results of testing to include the date, time, location and system component designations of material and equipment tested. Testing action shall be recorded whether successful or not. Reasons for termination of testing for any reason shall be recorded in the report. Testing work sheets, printouts, strip charts, oscilloscope or OTDR photographs, raw data, analyzed data and testing conclusions shall be included in the report. The Contractor shall deliver the performance verification test and endurance test procedures to the Government for approval. After receipt of written approval of test procedures, the Contractor may schedule the performance verification and endurance tests. The Contractor shall provide written notice of the performance verification test and the endurance test to the Government at least 2 weeks prior to the scheduled start of the test. The final performance verification test and endurance test report shall be delivered 30 days after completion of testing.

##### 1.3.4.2 Operation and Maintenance Data

A draft copy of the operation and maintenance data, in manual format, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

##### 1.3.4.3 Training Data

Lesson plans and training manuals, including type of training to be provided, with a list of reference material shall be delivered for approval

by the Government prior to starting any training.

#### 1.3.5 Group V Technical Data Package

The Group V package consists of the operation and maintenance data, in manual format. Final copies of the manuals bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and of the nearest service representative for each item of equipment and each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Manuals delivered shall include:

- a. Functional Design Manual: two copies.
- b. Hardware Manual: two copies.
- c. Operator's Manual: six copies.
- d. Maintenance Manuals: two copies.

##### 1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the data transmission system and explain the theory of operation, design philosophy, and specific functions. A description of hardware functions, interfaces, and requirements shall be included for all system operating modes.

##### 1.3.5.2 Hardware Manual

A manual describing equipment furnished, including:

- a. General description and specifications.
- b. Installation and checkout procedures.
- c. Equipment electrical schematics and layout drawings.
- d. Data transmission systems schematics.
- e. Alignment and calibration procedures.
- f. Manufacturer's repair parts list indicating sources of supply.
- g. Interface definition.

##### 1.3.5.3 Operator's Manual

The operator's manual shall fully explain procedures and instructions for operation of the system.

##### 1.3.5.4 Maintenance Manual

The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Fiber Optic System; GA.

Equipment calculations for flux budgets and gain margins.

#### SD-04 Drawings

Fiber Optic System; GA.

Detail drawings including a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function with its associated systems. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations. System drawings shall show final configuration, including location, type and termination of inside fiber optics and showing the location, duct and innerduct arrangement, or fiber assignment of outside plant. The ac power consumption and heat dissipation shall be shown under both normal and maximum operating conditions.

#### SD-06 Instructions

Manufacturers' Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be submitted prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

#### SD-08 Statements

Test Plans; GA.

Test plans shall define tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

#### SD-09 Reports

Test Reports; GA.

Test reports, in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

#### SD-13 Certificates

Manufacturer's certificate indicating compliance with transmission and reliability requirements. Where equipment or materials are specified to conform to the standards or publications and requirements of CFR, ANSI, NFPA, EIA, or UL, certificates attesting that the items furnished under this section of the specification conform to the specified requirements.

## PART 2 PRODUCTS

2.1 NOT USED

2.2 NOT USED

2.3 NOT USED

## 2.4 FO ANALOG REPEATERS

FO analog repeaters shall be used to extend the range of the FO data transmission system when necessary to meet the requirements of the paragraph SYSTEM REQUIREMENTS. For simplex circuits, the repeater shall consist of an FO receiver connected to an FO transmitter. For duplex circuits, the repeater shall consist of a pair of FO receivers that are connected to a pair of FO transmitters. The FO receivers shall receive the optical signal and drive the transmitters. The transmitters shall regenerate the optical signal in compliance with EIA 170. The FO repeater shall be mechanically and optically compatible with the remainder of the FO system.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

## 2.11 ENCLOSURES

Enclosures shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish.

## 2.11.1 Interior

Enclosures installed indoors shall meet the requirements of Type 12 or as shown.

## 2.11.2 Exterior

Enclosures installed outdoors shall meet the requirements [of Type 4] [of Type 4X metallic] [of Type 4X non-metallic] [as shown].

## 2.12 TAMPER AND PHYSICAL PROTECTION PROVISIONS

Enclosures and fittings of every description having hinged doors or removable covers, and which contain any part of the FO circuits or power supplies, shall be provided with cover-operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. The enclosure and the tamper switch shall function together to not allow direct line of sight to any internal components and tampering with the switch or the circuits before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision

at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door cover; and shall be wired so that they break the circuit when the door or cover is disturbed. Tamper switches on the doors which must be opened to make routine maintenance adjustments to the system and to service the power supplies shall be push/pull-set, automatic reset type. Covers of pull and junction boxes provided to facilitate installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by [security screws] [tack welding or brazing] to hold the covers in place. Zinc labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate that the box is part of a security system. Any damage to the enclosure or its cover's surface protection shall be cleaned and repaired using the same type of surface protection as the original enclosure.

## 2.13 SYSTEM REQUIREMENTS

### 2.13.1 Signal Transmission Format Code

FO equipment shall use the same transmission code format from the beginning of a circuit to the end of that circuit. Different transmission code formats may be used for different circuits as required to interconnect supported equipment.

### 2.13.2 Flux Budget/Gain Margin

FO links shall have a minimum gain margin of 6 dB. The flux budget is the difference between the transmitter output power and the receiver input power required for signal discrimination when both are expressed in dBm. The flux budget shall be equal to the sum of losses (such as insertion losses, connector and splice losses, and transmission losses) plus the gain margin. When a repeater or other signal regenerating device is inserted to extend the length of an FO circuit, both the circuit between the transmitter and the repeater-receiver, and the circuit between the repeater-transmitter and the receiver are considered independent FO links for gain margin calculations.

### 2.13.3 Receiver Dynamic Range

The dynamic range of receivers shall be large enough to accommodate both the worst-case, minimum receiver flux density and the maximum possible, receiver flux density. The receiver dynamic range shall be at least 15 dB. Where required, optical attenuators shall be used to force the FO link power to fall within the receiver dynamic range.

## 2.14 OPTICAL FIBERS

### 2.14.1 General

Optical fibers shall be coated with a suitable material to preserve the intrinsic strength of the glass. The outside diameter of the glass-cladded fiber shall be nominally 125 microns, and shall be concentric with the fiber core. Optical fibers shall meet EIA ANSI/EIA/TIA-455-46A, EIA ANSI/EIA-455-65, and EIA ANSI/TIA/EIA-455-177A.

### 2.14.2 NOT USED

### 2.14.3 62.5 Micron Multimode Fibers

Conductors shall be multimode, graded index, solid glass waveguides with a nominal core diameter of 62.5 microns. The fiber shall have transmission windows centered at 850 and 1330 nanometer wavelengths. The numerical aperture for each fiber shall be a minimum of 0.275. The attenuation at 850 nanometers shall be 4.0 dB/Km or less. The attenuation at 1330 nanometers shall be 1.5 dB/Km or less. The minimum bandwidth shall be 160

MHz-Km at 850 nanometers and 400 MHz-Km at 1300 nanometers. FO cable shall be certified to meet EIA ANSI/EIA/TIA-455-30B and EIA ANSI/EIA/TIA-455-58A.

#### 2.14.4 8.3 Micron Single Mode Fibers

Conductors shall be single-mode, graded index, solid glass waveguides with a nominal core diameter of 8.3 microns. The fiber shall have a transmission window centered at 1330 nanometer wavelength. The numerical aperture for each optical fiber shall be a minimum of 0.10. The attenuation at 1330 nanometers shall be 0.5 dB/Km or less. The fibers shall be certified to meet EIA ANSI/EIA/TIA-455-170.

### 2.15 CROSS-CONNECTS

#### 2.15.1 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system. Panels shall be a 19 inch rack mount type or wall mounted.

#### 2.15.2 Patch Cords

Patch cords shall be cable assemblies consisting of flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system. Patch cords shall be complete assemblies from manufacturer's standard products.

### 2.16 CABLE CONSTRUCTION

#### 2.16.1 General

The cable shall contain a minimum of two fiber optic conductors for each full duplex circuit. The number of fibers in each cable shall be as shown.

Each fiber shall be protected by a protective tube. Cables shall have a jacketed strength member, and an exterior jacket. Cable and fiber protective covering shall be free from holes, splits, blisters, and other imperfections. The covering shall be flame retardant, moisture resistant, non-nutrient to fungus, ultraviolet light resistant as specified and nontoxic. Mechanical stress present in cable shall not be transmitted to the optical fibers. Strength members shall be non-metallic and shall be an integral part of the cable construction. The combined strength of all the strength members shall be sufficient to support the stress of installation and to protect the cable in service. The exterior cables shall have a minimum storage temperature range of minus 40 to plus 167 degrees F. Interior cables shall have a minimum storage temperature of plus 14 to plus 167 degrees F. All cables furnished shall meet the requirement of NFPA 70.

Fire resistant characteristics of cables shall conform to Article 770, Sections 49, 50, and 51. A flooding compound shall be applied into the interior of the fiber tubes, into the interstitial spaces between the tubes, to the core covering, and between the core covering and jacket of all cable to be installed aerially, underground, and in locations susceptible to moisture. Flooded cables shall comply with EIA ANSI/EIA-455-81A and EIA ANSI/EIA/TIA-455-82B. Cables shall be from the same manufacturer, of the same cable type, and of the same size. Each fiber and protective coverings shall be continuous with no factory splices.

Fiber optic cable assemblies, including jacketing and fibers, shall be certified by the manufacturer to have a minimum life of 30 years. Plenum cable shall meet UL 910, and riser cable shall meet UL 1666. FO cable shall be certified to meet the following: EIA ANSI/TIA/EIA-455-13A, EIA ANSI/EIA/TIA-455-25B, EIA ANSI/TIA/EIA-455-41A, EIA ANSI/EIA/TIA-455-47B, EIA ANSI/EIA/TIA-455-59, EIA ANSI/EIA/TIA-455-61, EIA ANSI/EIA-455-88, EIA

ANSI/EIA-455-91, EIA ANSI/TIA/EIA-455-104A, and EIA ANSI/EIA-455-171.

## 2.16.2 Exterior Cable

### 2.16.2.1 Aerial Cable

The optical fibers shall be surrounded by a tube buffer, shall be contained in a channel or otherwise loosely packaged to provide clearance between the fibers and inside of the container, and shall be extruded from a material having a coefficient of friction sufficiently low to allow the fiber free movement.

- a. The cable outer jacket shall be medium density polyethylene material containing at least 2.6 percent carbon black with only black pigment added for additional coloring.
- b. Tensile strength: Cables shall withstand an installation tensile load of not less than 608 pounds and not less than 135 pounds continuous tensile load.
- c. Impact and Crush resistance: The cables shall withstand an impact of 1.7lbs/in as a minimum, and shall have a crush resistance of 317 pounds per square inch as a minimum.

### 2.16.2.2 Duct Cable

The optical fibers shall be surrounded by a tube buffer, shall be contained in a channel or otherwise loosely packaged to provide clearance between the fibers and inside of the container, and shall be extruded from a material having a coefficient of friction sufficiently low to allow the fiber free movement.

- a. The cable outer jacket shall be medium density polyethylene material with orange pigment added for ease of identification.
- b. Tensile strength: Cables shall withstand an installation tensile load of not less than 608 pounds and not less than 135 pounds continuous tensile load.
- c. Impact and Crush resistance: The cables shall withstand an impact of 1.7lbs/in as a minimum, and shall have a crush resistance of 317 pounds per square inch as a minimum.

## 2.16.3 NOT USED

## 2.16.4 Pigtail Cables

Cable used for connections to equipment shall be flexible fiber pigtail cables having the same physical and operational characteristics as the parent cable. The cable jacket shall be flame retardant PVC or FCP, which complies with NFPA 70 for OFNP applications. Maximum dB loss for pigtail cable shall be 3.5 dB/km at 850 nanometers, and 1.0 dB/km at 1330 nanometers.

## 2.17 FO CONNECTORS

FO connectors shall be the straight tip, bayonet style, field installable, self-aligning and centering. FO connectors shall match the fiber core and cladding diameters. The connector coupler shall be stainless steel and the alignment ferrule shall be ceramic. FO equipment and cable shall use the same type connectors. Connector insertion loss shall be nominally 0.3 dB and less than 0.7 dB.

## 2.18 MECHANICAL SPLICES

Mechanical splices shall be suitable for installation in the field. External power sources shall not be required to complete a splice. Splices shall be self-aligning for optimum signal coupling. Mechanical splices shall not be used for exterior applications where they may be buried underground or laced to aerial messenger cables. Mechanical splices may be used for interior locations and within enclosures. Splice closures shall protect the spliced fibers from moisture and shall prevent physical damage.

The splice closure shall provide strain relief for the cable and the fibers at the splice points.

## 2.19 CONDUIT, FITTINGS AND ENCLOSURES

Conduit shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR, and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, and as shown.

## PART 3 EXECUTION

### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Interconnections, services, and adjustments required for a complete and operable data transmission system shall be provided.

#### 3.1.1 NOT USED

#### 3.1.2 Aerial Cable

Except as otherwise specified, poles and associated aerial hardware for an overhead FO cable system shall be installed as specified in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL and as shown.

- a. A messenger cable system to support aerial cables shall be furnished. The messenger system shall be capable of withstanding a minimum of 4500 pounds of tension, including appurtenances, guys, and hardware. Messenger cables shall be galvanized zinc coated steel or aluminum clad steel.
- b. The messenger cables shall be grounded at dead ends, at the entrance to each facility, and at intervals not exceeding 1000 feet. New grounding conductors and electrodes shall be provided at each ground connection. Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.
- c. Aerial FO cables shall meet the horizontal, vertical and climbing space clearances prescribed in IEEE C2 and those of the installation.
- d. Transitions from aerial cable to underground cable shall be as specified for CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.
- e. Splices in aerial cable shall be within 3 feet of a pole and placed inside a watertight enclosure. Drip loops shall be formed at the cable entrance to the enclosure. Lashing clamps shall be placed within 12 inches of the enclosure.
- f. Loops shall be formed in the aerial cables at points of connection and at poles to prevent damage from thermal stress and wind loading. The communications cable shall be protected from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves. The ground clearance of installed

cabling shall be as shown.

- g. Cable shall be run vertically and when possible shall use gravity to assist in cable pulling. Cable shall be pulled from top of run to bottom of run. Cable shall be hand pull if possible. If machine assistance is required, tension shall be monitored using dynamometers or load-cell instruments and shall not exceed specified cable tension limits. After installation, the vertical tension on the cable shall be relieved at maximum intervals of 100 feet using a split support grip.
- h. Lashing wire shall be wound tightly around both the communication cable and the messenger cable by machine methods. The lashing wire shall have a minimum of 1 turn per 14 linear inches and not less than the number of turns per unit length that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wind loading shown or normally encountered loading for the installed location. Lashing clamps shall be placed at all poles and splices.
- i. The ice and wind loading conditions shall be per manufacturers recommendations for the geographical location:

### 3.1.3 Exterior Underground Cable

Except as otherwise specified, conduits, ducts, and manholes for underground FO cable systems shall be installed as specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown.

- a. Minimum burial depth for cable shall be 30 inches, but not less than the depth of the frost line. Burial depth specified shall take precedence over any requirements specified elsewhere.
- b. Where direct burial cable will pass under sidewalks, roads, or other paved areas and no existing conduits or duct banks are available, the cable shall be placed in a 1 inch rigid coated galvanized steel conduit or larger as required to limit conduit fill to 80 percent or less. Conduit may be installed by jacking or trenching, as approved.
- c. Buried cables shall be placed below a plastic warning tape buried in the same trench or slot. The tape shall be 12 inches above the cable. The warning tape shall be continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 48 inch intervals. The plastic tape shall be acid and alkali resistant polyethylene film, 3 inches wide with a minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 pounds per square inch lengthwise and 1500 pounds per square inch crosswise.
- d. Transitions from underground cable to aerial cable shall be as specified for CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown.
- e. For cables installed in ducts and conduit, a cable lubricant compatible with the cable sheathing material shall be used on all cables pulled. Pulling fixtures shall be attached to the cable strength members. If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics. If an indirect attachment is used on cables having only central strength members, the pulling forces shall be reduced to ensure that the fibers are not damaged from forces being transmitted to the strength member. During pulling the cable pull line tension shall be continuously monitored using

dynamometers or load-cell instruments, and shall not exceed the maximum tension specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall be such that the cable is not twisted or stretched. A cable feeder guide shall be used between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is unspooled from the reel. As the cable is unspooled from the reel, it shall be inspected for jacket defects or damage. The cable shall not be kinked or crushed and the minimum bend radius of the cable shall not be exceeded during installation. Cable shall be hand fed and guided through each manhole and additional lubricant shall be applied at all intermediate manholes. When practicable, the center pulling technique shall be used to lower pulling tension. That is, the cable shall be pulled from the center point of the cable run towards the end termination points. The method may require the cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole the cable shall be protected from dirt and moisture by laying the cable on a ground covering.

#### 3.1.4 Service Loops

Each fiber optic cable shall have service loops of not less than 9.8 feet in length at each end. The service loops shall be housed in a service loop enclosure.

#### 3.1.5 Metallic Sheath Grounding

Fiber optic cable with metallic sheath routed in the trench with a power cable shall have the metallic sheath grounded at the cable termination points.

#### 3.1.6 Splices

No splices will be permitted unless the length of cable being installed exceeds the maximum standard cable length available from a manufacturer or unless fiber optic pigtails are used to connect transmitters, receivers, or other system components for terminations to the fiber. Splices shall be made using the method recommended by the cable manufacturer. Splices shall be housed in a splice enclosure and shall be encapsulated with an epoxy, ultraviolet light cured splice encapsulant or otherwise protected against infiltration of moisture or contaminants. FO splices shall be field tested at the time of splicing. Fusion splices shall have less than 0.2 dB loss.

Mechanical splices shall have less than 0.5 dB loss. There shall be no more than 1 splice per 0.62 mile in any of the FO cables excluding terminations. Field splices shall be located in cable boxes. Sufficient cable shall be provided in each splicing location to properly rack and splice the cables, and to provide extra cable for additional splices. Cable ends shall be protected with end caps except during actual splicing. During the splicing operations, means shall be provided to protect the unspliced portions of the cable and its fibers from the intrusion of moisture and other foreign matter.

#### 3.1.7 Connectors

Connectors shall be as specified in paragraph FO CONNECTORS. Fibers at each end of the cable shall have jumpers or pigtails installed of not less than 3 feet in length. Fibers at both ends of the cable shall have connectors installed on the jumpers. The mated pair loss, without rotational optimization, shall not exceed 1.5 dB. The pull strength between the connector and the attached fiber shall not be less than 50 pounds.

#### 3.1.8 Identification and Labeling

Identification tags or labels shall be provided for each cable. Markers, tags and labels shall use indelible ink or etching which will not fade in sunlight, or in buried or underground applications. Markers, tags, and labels shall not become brittle or deteriorate for a period of 20 years. Label all termination blocks and panels with cable number or pair identifier for cables in accordance with EIA ANSI/TIA/EIA-606 and as specified. The labeling format shall be identified and a complete record shall be provided to the Government with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

### 3.1.9 Enclosure Sizing and Cable

Termination enclosures shall be sized to accommodate the FO equipment to be installed. Sizing shall include sufficient space for service loops to be provided and to accommodate a neat, workmanlike layout of equipment and the bend radii of fibers and cables terminated inside the enclosure.

### 3.1.10 Enclosure Penetrations

Enclosure penetrations shall be from the bottom and shall be sealed with rubber silicone sealant to preclude the entry of water. Conduits rising from underground shall be internally sealed.

### 3.1.11 Conduit-Enclosure Connections

Conduit-enclosure connections shall be protected by tack welding or brazing the conduit to the enclosure. Tack welding or brazing shall be done in addition to standard conduit-enclosure connection methods as described in NFPA 70. Any damage to the enclosure or its cover's surface protection shall be cleaned and repaired using the same type of surface protection as the original enclosure.

## 3.2 TESTING

### 3.2.1 General

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing.

### 3.2.2 Contractor's Field Test

The Contractor shall verify the complete operation of the data transmission system in conjunction with field testing associated with systems supported by the fiber optic data transmission system prior to formal acceptance testing. Field tests shall include a flux density test. These tests shall be performed on each link and repeated from the opposite end of each link.

#### 3.2.2.1 Optical Time Domain Reflectometer Tests

Optical time domain reflectometer tests shall be performed using the FO test procedures of EIA ANSI/EIA/TIA-455-59. An optical time domain reflectometer test shall be performed on all fibers of the FO cable on the reel prior to installation. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. Photographs of the traces shall be furnished to the Government. An optical time domain reflectometer test shall be performed on all fibers of the FO cable after it is installed. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. If the optical time domain reflectometer test results show anomalies greater than 1 dB, the FO cable segment is unacceptable to the Government. The unsatisfactory segments of cable shall be replaced with a new segment of cable. The new segment of cable shall then be tested to demonstrate acceptability. Photographs of the traces shall be furnished to the Government for each link.

### 3.2.2.2 Power Attenuation Test

Power attenuation test shall be performed at the light wavelength of the transmitter to be used on the circuit being tested. The flux shall be measured at the FO receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. If the circuit loss exceeds the calculated circuit loss by more than 2 dB, the circuit is unsatisfactory and shall be examined to determine the problem. The Government shall be notified of the problem and what procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare and submit a report documenting the results of the test.

### 3.2.2.3 Gain Margin Test

The Contractor shall test and verify that each circuit has a gain margin which exceeds the circuit loss by at least 6 dB.

## 3.3 TRAINING

### 3.3.1 General

The Contractor shall conduct a training course for designated personnel in the maintenance of the FO system. The training shall be oriented to the specific system being installed under this specification. The Contractor shall furnish training materials and supplies.

### 3.3.2 Maintenance Personnel Training

The system maintenance course shall be taught at the project site after completion of the endurance test for a period of 1 training day. A maximum of five personnel designated by the Government will attend the course. A training day shall be 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunchtime during the daytime shift in effect at the facility. Training shall include:

- a. Physical layout of the system and each piece of hardware.
- b. Troubleshooting and diagnostics procedures.
- c. Repair instructions.
- d. Preventative maintenance procedures and schedules.
- e. Calibration procedures. Upon completion of this course, the students shall be fully proficient in the maintenance of the system.

-- End of Section --